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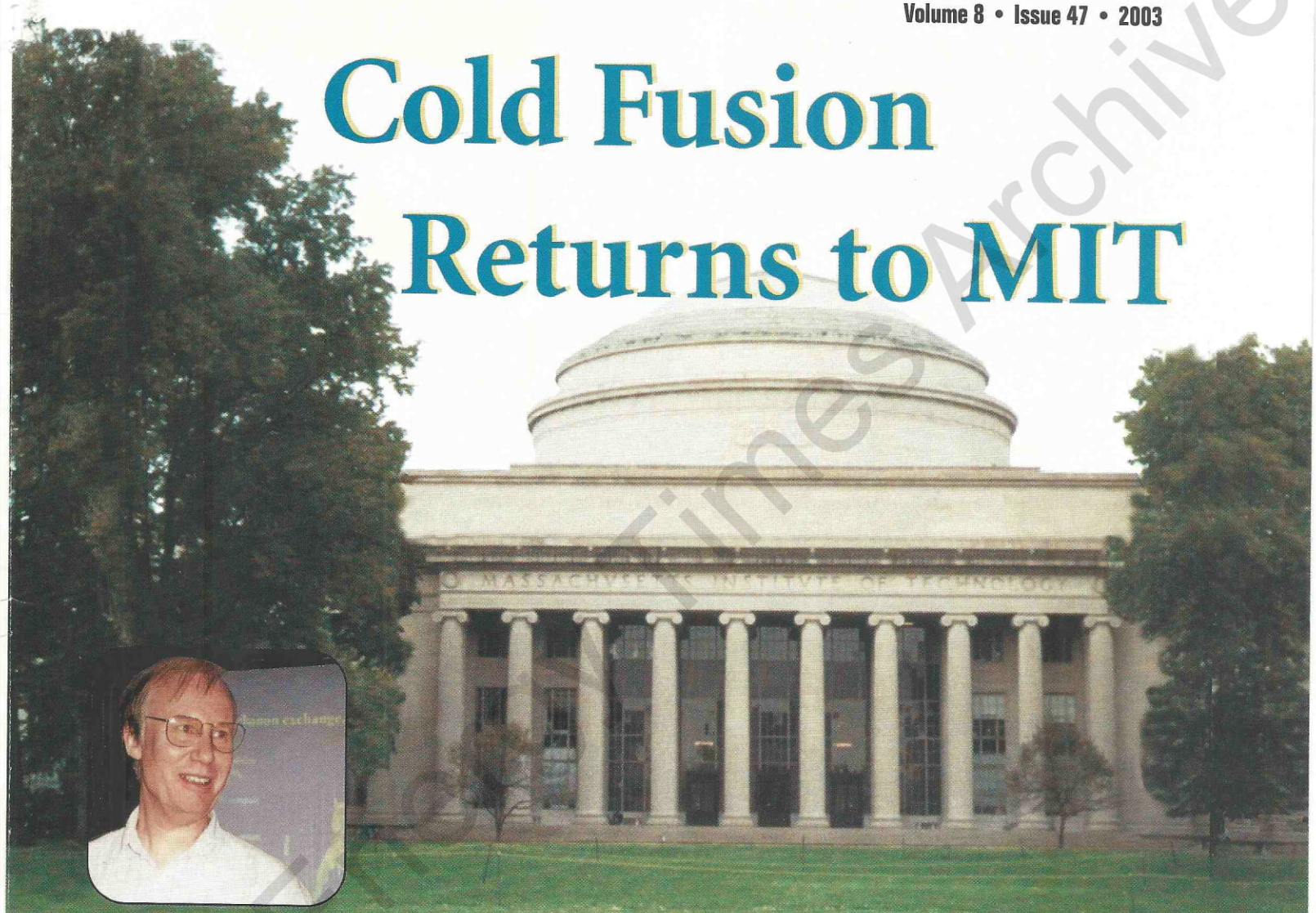
Volume 8 • Issue 47 • 2003

Cold Fusion Returns to MIT



MIT Prof. Peter Hagelstein Prepares for August's Tenth International Conference on Cold Fusion Near the "Bastion of Skepticism"

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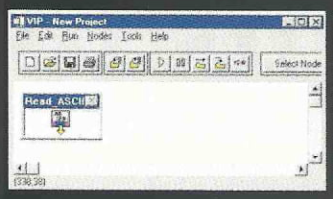

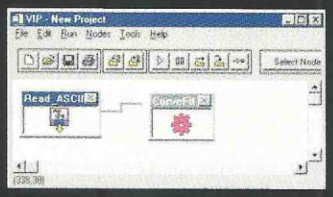

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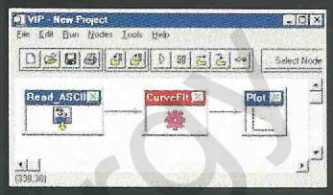

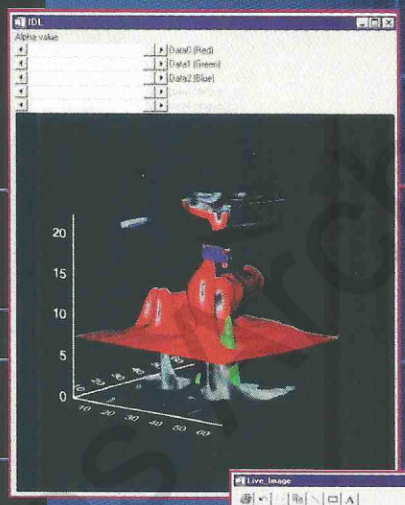

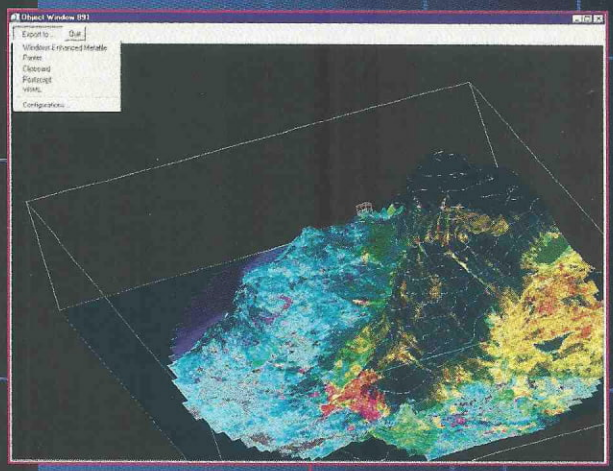

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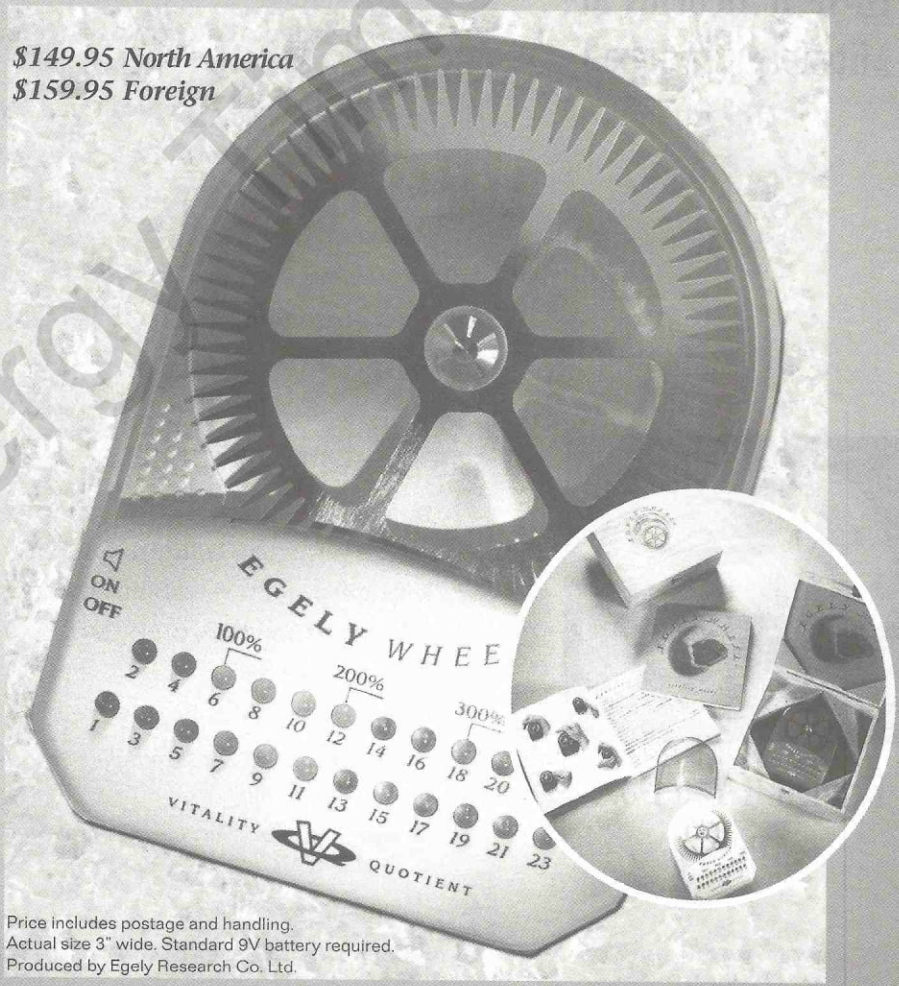

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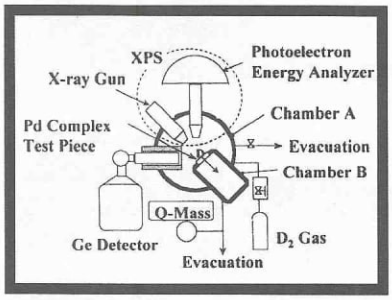

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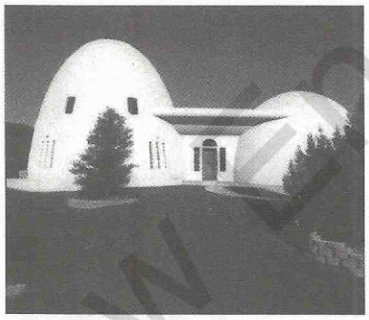

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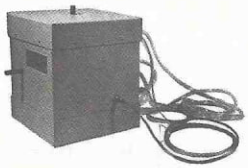

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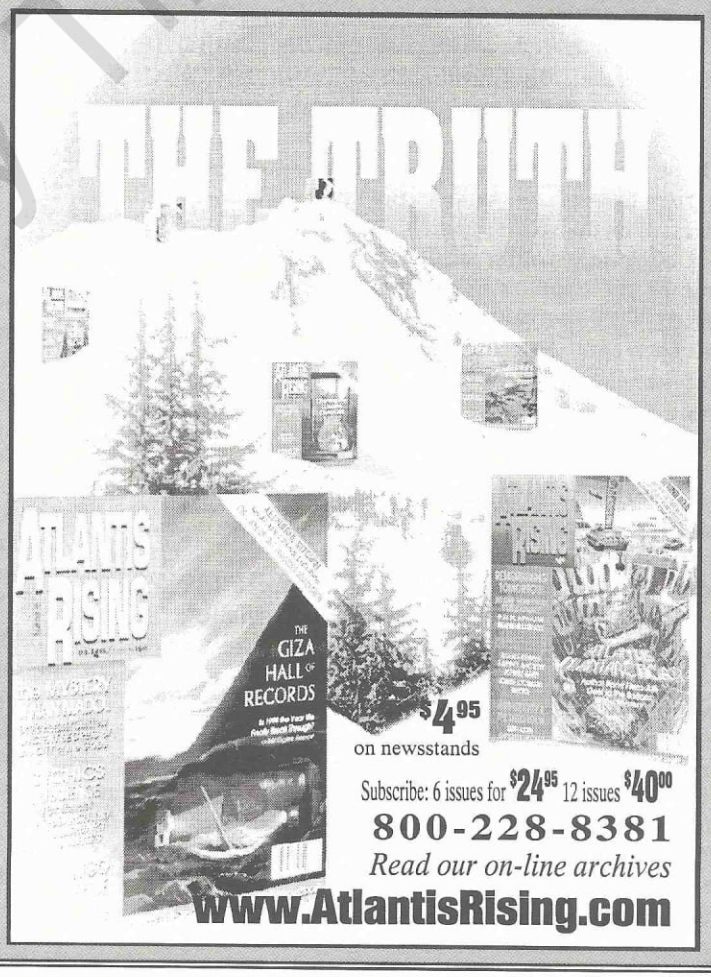

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LETTERS TO THE EDITOR

Addendum to Paper

I would like to submit an addendum to my recently published paper, "Hollow Conductors vs. Zero-Point Energy" (*IE* #45). I have been doing some additional thinking about the concept and have concluded that I did not proceed far enough in my original analysis. I asked and answered one principal question: Was the same amount of work required to charge a hollow conductor to a given charge level, depending on whether it was charged directly on its outer surface or indirectly on its inner surface? I then concluded that the amounts of work were different for the two techniques. More work was required for the direct method than the indirect method.

I should then have followed this with two more questions. Can the results of this work be accounted for in each case? Is this work recoverable, in principle, in both cases? I have concluded that the answer is yes to both questions for charging techniques and that, therefore, energy is conserved in both cases.

My reasoning is as follows. Assume the use of a small solid spherical conductor together with a larger hollow spherical conductor with an insulated opening through which the smaller sphere can pass. Initially position the two spheres well separated from each other and both electrically insulated from the earth. Now, charge the small sphere and then physically move it so that it comes in contact with the large sphere, on either its inner surface or outer surface.

If the small sphere contacts the inner surface of the large sphere, all of the small sphere's charge will be transferred to the large sphere's outer surface (assuming the Earth is the source of the charge's mirror image). This process can be repeated with the same increment of charge being transferred each time, but with more work required each time to force the charge toward and into the large conductor because of the increasing field intensity on the large conductor's outer surface. At the end of the charging process, all of the work expended is represented by the charge on the large sphere's outer surface and can be recovered by discharging the sphere to ground.

If the small sphere contacts the outer surface of the large sphere, only the amount of charge will be transferred to the large sphere, which will equalize the potential on the two spheres. For the next increment of charge to be transferred, the potential on the small sphere will have to be raised above that of the large sphere. Thus, as the charge and potential accumulates on the large sphere, so too will the charge and potential have to be increased on the small sphere. For each increment of charge, the net work to transport the charge to the large sphere will be the same as if the charge were introduced to the large sphere's inner surface. This is because the work required to force the total charge up to the large sphere can, minus the transferred charge, be recovered as the small sphere is allowed to move away from the large sphere in preparation for the next charge cycle. At the end of the charging process, all of the work expended is now represented by the sum of the charges on both the large and the small sphere. This work can be recovered by discharging both spheres to the ground. The difference in work between the indirect and direct charging methods is then the work expended and recovered in charging the small sphere.

From the above, I therefore conclude that I have not identified a new source of energy. Naturally this is disappointing but, after all, science is a search for the truth, no matter where it leads.

Durwood Creed
Stuart, Florida

Organization of Physics Research

On the issue of prospects for research in cold fusion, perhaps something could be learned from the software industry. The problem in physics is that established organizations have misguided priorities. The software industry has also had such problems in the concentration of, say, operating systems development, in certain large organizations, for the sake of efficiency. Physics organizations and academia also solve a problem, insuring qualifications of researchers funded, with a guild. Software has seen a new form of independent work with which to challenge the establishment, by organizing a competing institution, an independent association, in the open software movement and the Linux operating system, for example. This organization succeeds by having its own institutional discipline compared to merely dissociated independent work by different people apart from the establishment. Progress is achieved by having a small core of people with common standards to decide what is a valuable contribution, giving meaningful direction to many volunteers contributing to the effort in unscheduled ways.

Cold fusion and other independent physics does not seem to have any core group which can organize such a large-scale effort, nor any volunteers who would contribute to it. People exchange results, but don't plan a unified program. Equipment requirements may be one barrier, but theoretical work, fusion theory, is not so costly. Perhaps the difficulty of theoretical work in physics is a barrier. The increments obtainable from small personal commitments there may be too small to solve any problem the way someone writing a portion of Linux can produce a useable unit of software. Some grand unification must be produced all at once as a

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whole. But if this is not the case, perhaps more attention should be given to innovations in organizations which have been revealed in software.

George Lyons
Jersey City, New Jersey

LENR in Light Water

The experimental results of Miley *et al.*[1] on low energy nuclear reactions (LENR) in light water is of great interest. Trying to understand the observed transmutation of the electrode materials is a daunting task. Let me make some suggestions. I assume the electrolyte is lithium sulfate in light water, and the cathode is some combination of titanium, nickel, and palladium.

My guess is that a primary source of energy is the fusion of lithium-6 and deuterium to form a pair of alpha particles, the process being enhanced by the catalytic action of free neutrons, as described in my paper.[2] Here I am invoking the fact that heavy water occurs as a 0.015% impurity in light water.

Consider the isotopes of some element of atomic number Z. Energetic free neutrons can strip one or two neutrons from a nucleus, creating a lighter isotope and additional free neutrons. This process generally absorbs energy. A less energetic neutron may be absorbed by a nucleus, creating a heavier isotope. This process generally liberates energy. The presence of neutrons can change the naturally occurring isotopic abundance of an element.

The following appears to be true for every element for which $Z \geq 5$. The lightest isotopes of an element are unstable against decay by either electron capture or positron emission. Thus an isotope of element Z becomes one of (Z - 1). The heaviest isotopes of an element are unstable against decay by electron emission. Thus an isotope of element Z becomes one of (Z + 1). Both processes liberate energy.

Repeated use of neutron induced isotopic transformations and weak-interaction induced decays can transform the naturally occurring isotopic abundance of a single element into exotic isotopic abundances of a range of elements. It is amusing to get out the table of isotopes in the *Handbook of Chemistry and Physics* and trace out what can happen when one starts with titanium, nickel, or palladium.

Robert Parmenter
Tucson, Arizona

References

1. Miley, G.H., Selvaggi, G., Tate, A., Okuniewski, M., Williams, M.J., Chicea, D. 2000. *Proceedings of the Eighth International Conference on Nuclear Engineering*, April 2-6, Baltimore.

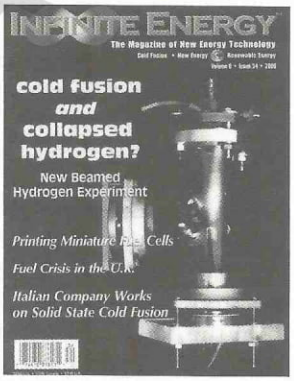
2. Parmenter, R.H. 2002. "Enhancement of Cold Fusion Processes in Palladium by Catalytic Agents," *Infinite Energy*, 8, 43, 66.

Electron Beam Experiment Results

Some time ago Dr. Mallove asked me to carry out my electron beam experiments in a size which would permit more reliable measurement of the heat which was produced, so I purchased a glass pipe only 5 inches in length and operated the electron beam using this pipe as the beam chamber. Some fascinating results have been obtained. A peak temperature of about 129°C was obtained, but in accordance with my calculations this was insufficient to provide excess heat since, at that time, almost 50 watts of electricity were consumed.

I attribute the production of large amounts of heat to an orange-colored beam extending from the anode. This anodic beam has never, in my experience, reached the cathode, and since this very short system had only a short space between the electrodes (about 3.25 inches), I doubted I could produce more watts of heat than watts of electricity used. Thus far, my doubt appears to be correct, because the orange beam was so short.

Attention is directed to the photograph of my experiment which was printed on the cover of *IE* #34. Dr. Mallove saw my experiment, so he knows the beam extending from the anode is narrow and orange in color, but in the picture that beam is white. Apparently invisible ultraviolet radiation, to which the photographic film was responsive, overwhelmed what we saw with the naked eye.



It is stressed that the visible orange beam was narrow and of equal brightness along its length. The white beam in the picture is brightest at the middle of the pipe and it is widest at that middle region. It is fascinating to note that the highest temperatures were recorded while the orange beam was present near the middle of the pipe, and not at either the cathode or the anode. It is also fascinating to note that at the start of the experiment, and regardless of what gas was within the pipe, the highest temperatures are recorded in the cathode region of the pipe. But when the experiment is successful in generating what I estimate to be excess heat, the lowest temperatures along the length of the pipe are recorded in the cathode region of the pipe. The published photograph also shows the cathode at the right side of the pipe covered with a lavender sheath of light, which is hydrogen cations capturing an electron as they converge on the cathode, and the anodic beam pictured did not reach the cathode.

In operating the short 5 inch pipe, less electric power is needed to ionize the gas in the pipe, so our experiment had excess electrical power and we could maintain ionization at higher gas pressure. As a result, when an orange beam extending from the anode was established, we were able to continue the experiment at progressively higher pressure using progressively greater electrical power (the number of watts consumed progressively increased). In this way we were able to increase the amount of material in the orange beam until there was too much of such material to fit within the about 3.25 inch spacing between the electrodes. At that time it was easy to observe that the cathode was still covered with a lavender sheath, but it repelled the orange beam, forcing that beam to bend.

The electrical power was then increased to maximum and the degree of curvature increased. Before the system

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became so resistive that the plasma failed, the orange beam became sharply curved and was measured to have been deflected at least half an inch from the normal straight line extension of the beam. This constitutes a powerful repulsion of that beam, which can only be explained if the beam is constituted by negatively charged particles.

In an electron beam, electrons move from the cathode to the anode and, as they do so, they knock electrons out of the atoms in the gas through which they pass. In this way one can produce a beam of positively charged atomic ions called cations because they migrate toward the cathode, but it is not possible to produce a negatively charged atomic ion, called a cation. When the cationic particles capture an electron, energy is emitted in the form of light. A beam which is repelled by the cathode must be constituted by negatively charged particles, and an electron beam cannot produce negatively charged particles. Nonetheless, the evidence now clearly demonstrates that negatively charged particles were produced and repelled by the cathode.

In my opinion, fractional hydrogen is formed, as reported in *IE* #34, when the atoms of fractional hydrogen associate with a free electron to form a negatively charged anion. Nothing else could have been formed because, by repeated exhaustion of the pipe followed by introduction of only hydrogen (albeit some absorbed air may be released by the various solid surfaces which are present), essentially only hydrogen in one form or another is available to provide negatively charged anions.

In the 1960s, my mentor Carl F. Krafft put aside his vortex theory of particles, because his proton expelled energy in both opposite directions, and since he attributed the positive charge to those opposite polar motions, his proton should be able to capture a second electron when he was aware that in hydrogen it captured only one electron. I modified the vortex proton, as explained in my texts, but it still had the capacity to capture a second electron, although in normal hydrogen the circulation of energy between the particles and the large spacing of those particles prevented the capture of a second electron. Now, when hydrogen is collapsed into fractional form, the second electron can come close enough to be captured. This would form a negatively charged ion, and that is what appears to have been formed. It is exciting to see how Krafft's vision has now been vindicated by experiment.

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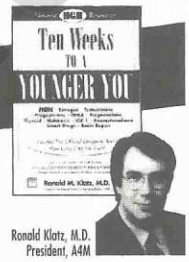

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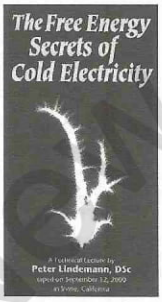

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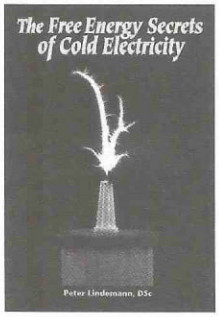

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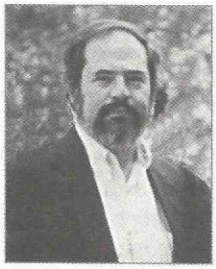
Cold Fusion Returns to MIT

by Eugene F. Mallove, Sc.D.



MIT is usually only too happy to lend its official imprint and sponsorship to conferences on subjects of scientific and technological importance. Holding such meetings on the MIT campus is common. But on August 24-29, 2003, when the Tenth International Conference on Cold Fusion (ICCF10) meets in Cambridge, Massachusetts, it will not be at MIT. Instead, cold fusion scientists will convene a few blocks away from MIT at the Royal Sonesta Hotel. They will come from Canada, China, France, Germany, India, Israel, Italy, Japan, Korea, Russia, the U.K., the U.S., and elsewhere—a struggling, highly underfunded community of researchers. Will MIT President Charles Vest or any other high-level MIT dignitary be there to welcome the participants? Not a chance.

The organizing chairman of ICCF10, who *will* greet the attendees, is MIT Associate Professor of Electrical Engineering and Computer Science, Peter L. Hagelstein, who in April 1989 became one of the earliest proponents of *coherent* metal lattice dynamics theories as the underlying generic mechanism for cold fusion phenomena. That academic "impropriety" has earned Hagelstein no honors at MIT—quite the contrary. But with the advent of ICCF10, cold fusion will, in a manner of speaking, have "returned to MIT"—to haunt it, to annoy it with a remembrance of things past that are not pleasant. In some sense, cold fusion can't ever *return* to MIT, for in truth it never really left.

We are now almost fourteen years into the cold fusion controversy, which began with the March 23, 1989 announcement by Drs. Fleischmann and Pons at the University of Utah. The more things change, the more they stay the same: Less than twelve hours after the 1989 cold fusion announcement, the Exxon Valdez (recently de-commissioned for scrap in 2002!) had run aground and spilled millions of gallons of oil into the pristine waters off Alaska. In November 2002, another oil tanker has spilled a few million more gallons, off the coast of Spain; it has sunk to the ocean floor and will likely continue to exude oil for years. Had the scientific process gone the way it should have, cold fusion by now might have begun to end oil spills forever, as the horrors of the Fossil Fuel Age receded.

On April 14, 1989 during the height of the cold fusion furor, Professor Hagelstein gave a talk on cold fusion theory at MIT to a packed, *closed-door* meeting of a few hundred faculty and staff who hung on and debated his every word. On November 4, 2002, Hagelstein gave an *open-door* cold fusion seminar in the very same room at MIT, this one under the auspices of his department's Research Laboratory for Electronics (RLE). Only about thirty-five stragglers came. This intentionally understated notice had appeared on campus bulletin boards and had made its way to Internet discussion groups:

SPECIAL RLE SEMINAR

Monday, November 4, 2002
Grier Room B, 34-401B
Refreshments at 3:45 p.m.
Talk at 4:00 p.m.

Are There New Physical Mechanisms Associated with the Anomalies in Metal Deuterides?

Professor Peter L. Hagelstein, MIT

Low-level neutron emission from TiD was claimed by Jones in an electrochemical experiment in March of 1989. Pons, Fleischmann, and Hawkins claimed an excess heat effect in PdD in electrochemical experiments, also at the same time. It was shown that the screening between deuterons was insufficient to account for the effect claimed by Jones. In the case of the Pons and Fleischmann effect, the associated theoretical problems were far more severe: To obtain a heat effect of nuclear origin without associated radiation, some kind of new physics and associated reactions would be required. Moreover, whatever new process was to account for the effect, it had to dominate by many orders of magnitude over the conventional fusion reaction pathways. In the absence of replications of either experiment at respected labs, by mid-1989 both claims were rejected by the scientific community.

Several hundred researchers around the world were uncomfortable with such a quick dispatch of these claims, and continued to work on the problem over the years. After hundreds of experiments, nine international conferences, and several thousand manuscripts, the community that has continued to pursue the general topic of anomalies in metal deuterides has more or less reached a consensus that there are a variety of real effects that are deserving of serious scientific research. A variety of unexpected effects are presently claimed, including low-level fusion and heat; observations of helium in association with excess energy; substantial accumulation of tritium; fast charged particles that are not from dd-fusion reactions; induced radioactivity; and transmutations.

I will outline briefly in the talk some of what I con-

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sider to be key experimental results that appear to shed light on the physical mechanisms that are involved. I have recently proposed a relatively straightforward model based on phonon exchange effects in an effort to understand the anomalies, which I will present in the talk. The new model appears to allow for an interpretation of most of the anomalies, and suggests the possibility of an unambiguous clarification of the physical basis of the effects.

Some background on the talk, which Peter Hagelstein e-mailed me before the meeting (after my inquiry):

> I was invited to give a colloquium earlier at Berkeley [September 30] to the Nuclear Engineering Department. . .The Berkeley talk was well received. There were a relatively small number of attendees [since I gave a "stealth" title and abstract, so as not to embarrass my hosts], including some important nuclear physicists from the Physics Department. The talk was interactive, and when everyone had a chance to air their questions, some good got done. I got some positive feedback from it.
>
> I had decided to give a talk at MIT this fall as well, since in my view things have gotten to the point that we are beginning to know something about what is going on. . .It is not really possible for me to do a "stealth" mode talk at MIT, due to the history. After three different drafts of title and abstract, I ended up deciding on one that was just straightforward. . .I have no idea what is going to happen. I am hoping for an interactive talk with a smallish but interested audience. . .In my view, the primary purpose of the talk is to inform the MIT people in my department and lab about what I have been interested in, and to provide an overview of some of the results that I have obtained.—PH

The talk in the oak-paneled Grier room was, indeed, smallish, not well-attended. About ten of those present were the "converted" already—myself, other MIT graduates Dr. Mitchell Swartz and Dr. Brian Ahern, retired MIT Prof. Keith Johnson, Dr. Graham Hubler from the Naval Research Laboratory, and a few others. The others were mostly students. There were only a few professorial-looking people there. None of the bitter enemies of cold fusion came—the subject has been so killed off, in their view I'm sure, that there was no need to show up. It was a most depressing meeting, overall—the passage of time and the unfulfilled dreams for cold fusion being all too evident. Peter did give an unusually clear explanation of his theory, which he nicely integrated with some of the experimental evidence. But by his own admission later, he fell short by not mentioning right up front the *huge* amount of confirming evidence that already exists! If anything, he *downplayed* the evidence and focused on theory instead. He somehow failed to mention anywhere in his lecture the multiple reproductions of MIT graduate Dr. Les Case's helium-heat correlation in catalytic fusion experiments at SRI. So, most of the talk was devoted to the hairy mathematics of how Peter's lattice phonon energy exchange mechanisms work to bring nuclear energy into the atomic realm. Some of the more erudite in the audience, who were new to the subject, evidently were encouraged by the existence of a plausible theory for the disputed phenomena. I suppose we should be grateful even for such limited progress.

A most important MIT person *was* at the meeting—Prof. Mildred Dresselhaus, who during the last year or so of the Clinton Administration headed the U.S. DOE Office of Energy Science. She had signed the negative DOE report in 1989, but has been friendly with Prof. Hagelstein for many years, and to her credit has continued to be interested in cold fusion. But during her brief stint at DOE, Dresselhaus evidently didn't pull any strings for greater openness toward cold fusion either at DOE or at MIT, though she could have. This is cowardice, plain and simple. She failed to stand up for what she evidently can see is something that obviously needs a second chance—*an official re-evaluation*. Today, with no help from Dresselhaus, a handful of cold fusioneers in official and semi-official positions are engaged in an effort, likely to be futile, to bring about a $10 million cold fusion rebellion from *within* DOE! Hope springs eternal among the desperate. But I wish the rebels well and, other than these remarks, I won't "blow their cover." It might actually *help* them if the APS's Park found out about it and mentioned it in his column!

After thirteen years in the cold fusion war, I've personally had quite enough of the Establishment's shenanigans. The mob-rule treatment of cold fusion has alienated me from MIT, from the scientific community, and from the whole business of academic science in general. We spend billions and billions of dollars on all manner of dead end projects, and this "little project" of cold fusion—with potentially *huge* consequences—is given *nothing* at all. In fact, it is kicked down endlessly by paid thugs—the hot fusioneers and the well-funded "theory-of-everything" high energy physicists. Now cold fusion is simply dead, as far as the academic gangsters are concerned.

No news reporters came to Hagelstein's November seminar, not even from the MIT student newspaper, *The Tech*. Dr. Swartz and I tried to get *The Tech* to attend by going to its offices a few hours before the meeting and explaining to them why they should cover this; at least they listened. Some of those young "kids" were barely out of diapers when cold fusion was big news! How depressing. I had faxed the MIT official newspaper, *MIT Tech Talk*, for which I used to write before I resigned in disgust in June 1991. No reporter came—a deliberate slap in the face. *Tech Talk* has run full-page stories about MIT's hot fusion projects in recent times. Neither the *Boston Globe* nor the *Boston Herald* was there. It may have been just as well; there were no visible heated science politics for them to cover. They could at least have managed a story under this rubric: "MIT Professor Continues Difficult Quest for Cold Fusion." Something like that would have been appropriate.

Cold fusion continues to flounder in the doldrums, to which the scientific establishment maliciously consigned it. It therefore falls to the upcoming ICCF10 in Cambridge to effect a virtually miraculous sea state change. It may happen, let us hope. ICCF10's high profile venue is a critical opportunity for cold fusion to show its merit and promise, and for that we have MIT to thank. Many eyes will be on ICCF10 due to the extraordinary role that MIT played in the history of cold fusion.

On the occasion of the tenth anniversary of the startling announcement by Drs. Fleischmann and Pons on March 23, 1989, *Infinite Energy* (in *IE* #24) explored the major role of MIT in shaping the history of the investigation of cold fusion. That 55-page report will soon be available in full for free downloading (in pdf format) from our website (www.infinite-energy.com).

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But because the subject of MIT's responsibility is of such overarching importance—because of the issues of scientific ethics involved—let me abstract liberally from what I have written earlier.

Excess power evolution and unexpected ("impossible") nuclear changes in hydrogen-metal systems come under the rubric "cold fusion." Whatever its complete microphysical explanation turns out to be, cold fusion is of surpassing importance from the perspective of both science and technology. MIT's role in this affair bares close scrutiny by all who value what they assume MIT stands for: the open-minded quest for the truth about Nature and the application of new discoveries in science toward the betterment of humanity. What MIT's record says about the actions and inactions in the area of cold fusion by one of the world's great technical universities has far-reaching implications for *everyone* interested in the heated cold fusion controversy.

Unfortunately, many people still believe that the claims of a new, clean, abundant energy source and nuclear reactions occurring near room temperature were quickly and definitively disposed of by the careful work of scientists at MIT in the spring of 1989. Nothing could be further from the truth. These investigators at MIT did *not* produce definitive work. In fact, quite the contrary. A great opportunity for pioneering by MIT was missed and the baby *was* thrown out with the bath water—at least temporarily.

The actions of certain MIT staff members in 1989 were a major influence on the news media, on other scientists, and on the funding support for cold fusion. This is a matter of record. Though a small group of open-minded, involved faculty, staff, and alumni pursued and continue to pursue cold fusion, MIT as a whole did, indeed, acquire the deserved reputation as a "Bastion of Skepticism" on cold fusion. Sad to say, it was initially only a handful of MIT staff and faculty who gave MIT this reputation. They inappropriately drove many others—on campus and off—to dismiss the claims from Utah in 1989 and the research that has followed.

Perhaps the greatest hope lies in the youth—the students and graduates of MIT (and of other colleges and universities) who will examine the scientific literature objectively (a growing body of this technical literature can be downloaded from http://lenr-canr.org). Most MIT professors today are simply oblivious to the subject. If they were to examine the research record of the past decade they would readily see the opportunities to enter what is clearly an area of enormous potential. MIT students and alumni/ae may need to become catalysts that move faculty members and administration in the right direction, away from the present untenable position of denying well-established experimental facts and the theoretical developments by professors such as Peter L. Hagelstein and Keith H. Johnson, formerly of the Department of Materials Science and Engineering.

The events of 1989-1992 are past history, but one must learn from the past or be condemned to repeat it. As the record shows, the first assault against the truth in 1989 was press manipulation by faculty members engaged in the lavishly funded hot fusion research at MIT's Plasma Fusion Center (PFC). They did not believe the Utah work at all. They suspected that Pons and Fleischmann were engaged in a "scam," and they were concerned that if the public were to have a too open-minded attitude toward the prospect of cold fusion as an energy solution, funding for their beleaguered thermonuclear program would be endangered—even more so than in its perennial brushes with budgetary extinction.

The truth about the calorimetry experiment performed at MIT in 1989 under DOE contract funding (DOE Contract DE-ACO2-78ET51013) is stark and unambiguous. Its purported "negative" result was used to influence the U.S. Department of Energy's rushed 1989 report against cold fusion. In alphabetical sequence, it is the very first report cited in the U.S. DOE's ERAB Cold Fusion Panel report of 1989. Some would characterize the data manipulation in the sixteen-author MIT paper of 1989 as mere "data fudging." We do not mince words: the use of improperly handled scientific data to draw in the public mind and in the mind of the scientific community a completely false conclusion about an emerging discovery of overarching importance to humankind is high-level scientific misconduct, plain and simple.

It is remarkable that in 2002 the press can lavish such attention to recent instances of apparently egregious fraud in some mainstream physics areas, yet be unwilling to tackle a scientific fraud with far wider significance. We do not know for certain who unethically manipulated the data in the cold fusion reproduction experiment at MIT, and that is not important, but it was, indeed, inappropriately manipulated. "Inappropriately manipulated" is actually a very charitable way of describing what was done. We *do* know, however, that this erroneous study in the spring of 1989 at the MIT Plasma Fusion Center was *defended* by then Plasma Fusion Center Director Ronald M. Parker. Parker continues to play a leading role in hot fusion. For several years after leaving the MIT Plasma Fusion Center, he was stationed at the ITER (International Thermonuclear Experimental Reactor) in Garching, Germany. Since 1989, the U.S. government has funnelled billions of dollars into magnetically confined thermonuclear fusion development on projects, such as ITER. Though ITER funding was killed by the U.S. Congress years ago, funding of tokamak hot fusion continues at MIT and elsewhere. There is now a major push to get the U.S. back into the ITER funding racket (see p. 36).

The record is clear: Had MIT researchers behaved responsibly and ethically as scientists in the spring of 1989, it is most probable that a position of open-mindedness by MIT on the difficult subject of verifying the Utah claims would have averted the highly negative U.S. Department of Energy Report drafted in the summer of 1989. History would have been far different. Most likely, expensive engineering programs aimed at hot fusion reactors would have been cancelled in the early 1990s; plasma physics studies would have continued at MIT, and MIT researchers, including those at the Plasma Fusion Center, might have become the most eminent cold fusion researchers in the world.

It was not to be. Cool heads could have reserved judgment. They could have followed the experimental facts where they would ultimately lead, but they chose not to. Heads were not cool, they were hot. MIT could have been in the vanguard of the new scientific field as befits its leadership role in science, but this did not happen. MIT chose—and is continuing to choose—defense of its existing professional support from the Federal government over meticulously documented evidence of a new scientific field and the pathway to revolutionary technologies. In fact, the current President of MIT, Dr. Charles M. Vest, who ignored my written concerns in 1991-1992 and those of Dr. Mitchell R. Swartz, is on a Federal panel that now

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has major impact on U.S. DOE energy research funding. Dr. Vest played a key role in papering over the misdeeds of 1989. To use press manipulation and data manipulation to misdirect billions of dollars in Federal scientific funding is scandal of the highest order.

To use the phrase "scientific schlock," which then MIT Plasma Fusion Center Director Prof. Ronald M. Parker used against Fleischmann and Pons' work in 1989 (and later falsely denied using it, perhaps fearing legal action), aptly characterizes the methods used by certain MIT researchers against the new science of low-energy nuclear reactions. It was not only data manipulation or "processing," as Parker later would contend on the 1994 BBC and Canadian Broadcasting Corporation cold fusion documentary "Too Close to the Sun," but there was a whole range of dirty tricks, deceptions, and self-deceptions that MIT professors and senior officials employed against cold fusion.

Some may say, "Why drag up the negative past? Why not just emphasize the positive in the pages of your magazine?" To some degree that argument has merit, and we would like to be as positive as we can be. But we cannot ignore the reality that MIT's reputation as a "bastion of skepticism" against cold fusion has had a devastating effect on the progress of scientific investigation. The U.S. Patent and Trademark Office is using bogus conclusions from MIT investigators in 1989 to deny U.S. citizens their Constitutional rights to be granted patents on their intellectual property. Some of those are MIT graduates! If generations of MIT students, alumni/ae, and professors do not learn from the tragic errors of the past, how can the future be anything but dim?

How can the scientific and technological might and the vast resources of MIT be turned to this most important scientific problem of cold fusion and new energy, if the subject is relegated to nonsense and pseudoscience by past unacknowledged misdeeds—done by *individuals*, but with the implied imprint of MIT? How many scientists are not tuned into cold fusion precisely because in their minds MIT's "smart people" back in 1989 proved that there was nothing to cold fusion claims? Lots. We hear from them all the time.

MIT's Plasma Fusion Center (PFC) continues to receive tens of millions of dollars per year for its tokamak hot fusion program. This clearly makes no sense now that cold fusion has begun to demonstrate its commercial potential as both an energy source and in the low-energy remediation of radioactivity generated in the past from the commercial and defense industry fission nuclear enterprises. Who would wish to waste further billions of dollars on a technology—hot fusion—that has already come under serious question for its technological and economic viability as a twenty-first century energy source, *if* there were a clear alternative?

At least one alternative *is* here—low-energy nuclear reactions (LENR), a.k.a. "cold fusion." Does the world want it badly enough to find some way to pay for this research? If most governments won't fund it, will entrepreneurs and venture capitalists? Not many of the latter have stepped forward. And if venture capitalists won't fund LENR, who will? Will people of generous spirit consider *donating tax-deductibly* with *targeted* contributions for this research through the mechanism of the charitable New Energy Foundation, Inc. (www.infinite-energy.com)? One can hope. The grand experiment begins now. ❑❑❑

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"INFINITE" WATER:
A Breakthrough in Water Purification

Eugene F. Mallove

Next to clean, cheap, and abundant energy, at the top of any wish list for this Blue Planet is clean, cheap, and abundant water.

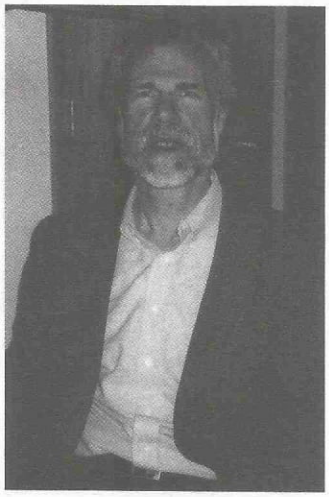
Yet we are far from a world where fresh water is cheap, clean, and abundant. An estimated 2.5 to 3% of all Earth's water is fresh (not saline), and most of that is either inaccessible (two-thirds of fresh water is polar ice) or not potable. Clearly, that miracle substance, water, without which we die, can't be taken for granted. Millions of people die every year for want of it, or from consuming it when it is polluted. Nations war over it as if it were oil! Today it is estimated that more than 1.7 billion people do not have clean drinking water. Many aquifers in the developing world have become contaminated and severely depleted due to population growth and inadequate waste disposal.

Now imagine that someone has developed a very small device—with *no* disposable parts, chemicals, or filters—that can produce 99.9999% pure and ultra cheap water, even right from a sewage supply or the most toxic industrial effluent. That would be almost as wonderful as the apocryphal working "free energy" machine. In fact, such a water device, in prototype form, has already been built and tested by a small company in a New England town. It is real—I have seen it working.

Ovation Products Corporation makes its home in an unassuming rural neighborhood on the outskirts of Nashua, New Hampshire. For the past decade, a growing team of now about a dozen engineers, technicians, and support staff have labored over a prototype water purification wonder device. It could revolutionize water consumption, the construction industry, and much more. One of Ovation's prototypes has been at work around-the-clock in far off Minnesota, making pure water directly from a septic tank! (One of Ovation's patents covers that extreme application.) The diminutive, fire-hydrant-sized machine (the prototype is a bit bigger) will soon begin to be manufactured in quantity for beta-site testing. It extracts pure from polluted water for less than a two-tenths of a cent per gallon in cost of electricity, its only operating expense. Remember, no filters or chemicals are needed. It produces from 12 to 20 gallons of water per hour, this from a device weighing only 60 pounds. In other words, it will be able to produce about two or more times its own weight in pure water every hour!

Such a wonder machine, already operating at the very limits of theoretical performance and extremely thermodynamically efficient, will eventually be produced by the millions and used in multi-modular fashion in homes, factories, and distant villages. The very existence of these hamlets may eventually depend on it. Money will be made, to be sure. Lives will be saved. That's the plan.

The Ovation device is the brainchild of entrepreneur and mechanical engineer Bill Zebuhr, a Cornell University graduate. Zebuhr's device has patent protection in depth, with at least five U.S. patents issued since 2001, and a dozen more filed. The 58-year-old company founder says that when large-scale mass-production begins in the next several years, his device will be one-tenth the cost, one-tenth the size, and one-tenth the weight of the closest comparable product—a hulking industrial machine made in Germany. The Ovation purifier is "mechanically very simple, but technically complex," says Zebuhr. Another big plus: the product has the potential to create many new markets for cleaning water, due to its ease of use and low cost.



Bill Zebuhr, Ovation Products Corporation President

Ovation's unit relies on a state-of-the art vapor compression distillation cycle, which *by definition*—but confirmable by testing—produces 99.9999% pure distilled water. Distillation removes *everything*—bacteria, viruses, heavy metals, chemicals, and suspended solids. Other processes, such as ultrafiltration and reverse osmosis,

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Such a wonder machine, already operating at the very limits of theoretical performance and extremely thermodynamically efficient, will eventually be produced by the millions.

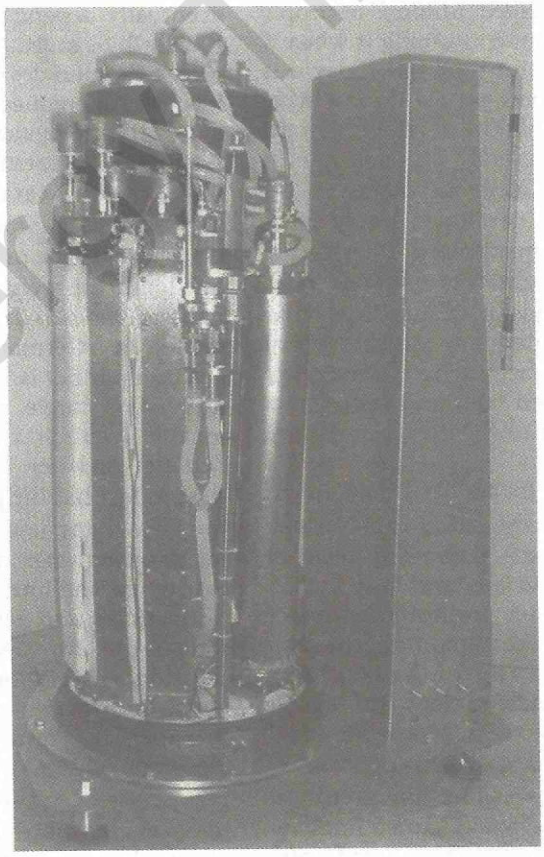
require high-energy input, do not produce perfect water quality, and degrade over time. Filters and cartridges are not needed with Ovation's technology. The compact unit relies on a breakthrough compressor design and a revolutionary rotary heat exchanger.

Today, the trend in the delivery of energy is toward decentralized, distributed power systems, disconnected from the aging power grid. Ovation's technology extends that concept to water purification. It may be that some of the first applications of the technology will be in factories, for detoxifying industrial effluents—because it will be highly cost- and performance-competitive with existing problematic technologies. Effluent could be treated right at each factory machine if necessary. The high cost of discharging contaminated water would be a thing of the past.

Concurrently, the Ovation water technology may begin to affect the home construction industry, permitting dwellings in places with grade and soil conditions that are now inadequate for proper leaching fields. Expensive homes sited near lakes and wetlands could benefit greatly. With Ovation's technology, a builder could construct a larger home on a site that would ordinarily be able to support only a two or three bedroom design. Thus, the cost of the Ovation unit would be more than compensated for by the advantages to the builder. The concentrate removed to purify the water would remain in the home septic tank, sans leaching field, which would be pumped out as usual every few years. Of course, regulatory policies would have to change to allow the ultra-pure water extracted from septic tanks to be expelled on or near the surface. By good fortune, water treatment regulations are already in flux and are ripe for such a change. In certain states, *e.g.* North Carolina, regulations already permit surface expulsion of septic water treated with expensive aerobic treatment devices. The Ovation machine would apparently beat the pants off such devices. Also, costly and unsightly "mound system" leaching fields might become quaint architectural curiosities from the twentieth century.

Eventually, Ovation's technology could become the standard water treatment of choice, even for well water in individual homes, which now rely on a bestiary of troublesome technologies designed to remove metals and other toxins. The yearly cost to a consumer based on current electric rates would be only about $200/year for a family of four. Another obvious application: waste water purification for coin-operated laundries.

First generation eight gallon per hour distiller.



Eight gallon per hour distiller with vacuum insulation cover removed.

With a technology of such diverse application and so potentially disruptive, it is difficult to predict what its market impact will be. Bill Zebuhr's water purifier emerges from its cloak of secrecy just as another New Hampshire inventor Dean Kamen thrusts his Segway personal transportation system with great fanfare into the world arena—another technology whose impact is tough to predict. Kamen himself understands the central importance of water purification. In a recent *Vanity Fair* (May 2002) profile of Kamen, the enigmatic inventor was quoted: "What are the three biggest problems in the emerging world? They don't have clean water, they don't have transportation, and they don't have power. If we engineer this thing right, we can give them all three." It seems that Ovation's technology may well solve Kamen's "problem number one"—let's call it the "infinite" water problem, for want of a better term. Kamen claims to

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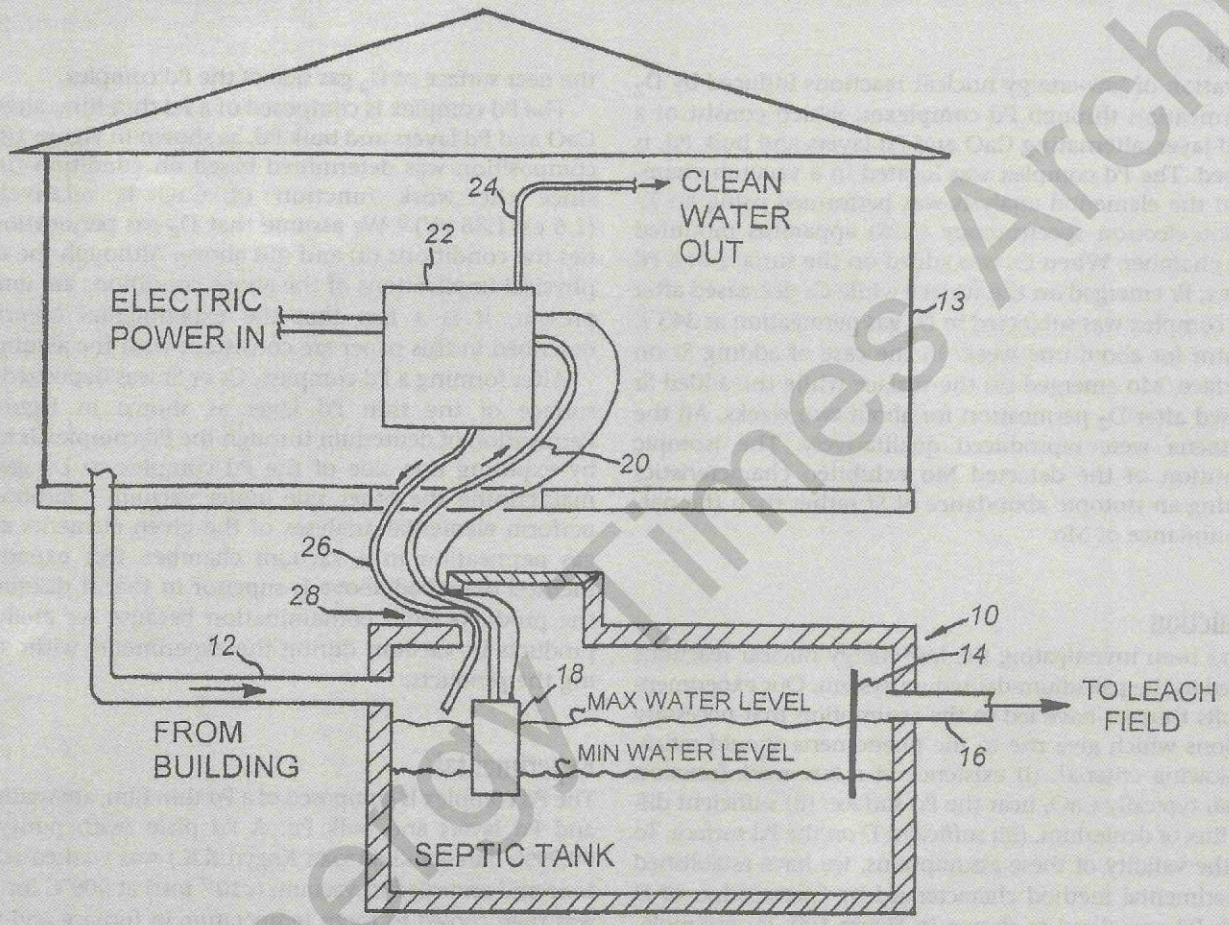
be conquering number two with Segway. Can a solution to number three—abundant, cheap, clean energy—be far behind? Probably not.

Ovation Products Corporation Patents:

- U.S. Patent #6,238,524 B1, May 29, 2001: "Rotating Plate Heat Exchanger"
- U.S. Patent #6,261,419 B1, July 17, 2001: "Rotating Plate Heat Exchanger"
- U.S. Patent #6,319,408 B1, November 20, 2001: "System for Processing Waste Water"
- U.S. Patent #6,328,536 B1, December 11, 2001: "Reciprocating Low Pressure Ratio Compressor"
- Another U.S. patent has been "allowed," but not yet assigned a number by the U.S. Patent and Trademark Office.



One of the more unusual applications of Ovation's device would eliminate the leaching field of septic systems (a drawing from one of Ovation's U.S. patents).

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Observation of Low-Energy Nuclear Reactions Induced By D_2 Gas Permeation Through Pd Complexes

Yasuhiro Iwamura,* Takehiko Itoh,** Mitsuru Sakano,** and Satoshi Sakai**

Abstract

Observation of low-energy nuclear reactions induced by D_2 gas permeation through Pd complexes, which consist of a thin Pd layer, alternating CaO and Pd layers and bulk Pd, is described. The Pd complex was located in a vacuum chamber and the elemental analysis was performed using an X-ray photoelectron spectroscopy (XPS) apparatus mounted on the chamber. When Cs was added on the surface of a Pd complex, Pr emerged on the surface while Cs decreased after the Pd complex was subjected to D_2 gas permeation at 343°K and 1atm for about one week. In the case of adding Sr on the surface, Mo emerged on the surface while the added Sr decreased after D_2 permeation for about two weeks. All the phenomena were reproduced qualitatively. The isotopic composition of the detected Mo exhibited characteristics indicating an isotopic abundance of Sr rather than the natural abundance of Mo.

Introduction

We have been investigating the low-energy nuclear reactions observed in the palladium-deuterium system. Our experimental results thus far have led to the assumption that necessary conditions which give rise to the phenomena should satisfy the following criteria[1]: (i) existence of a low work function material, typically CaO, near the Pd surface; (ii) sufficient diffusion flux of deuterium, (iii) sufficient D on the Pd surface. To check the validity of these assumptions, we have established an experimental method characterized by "permeation of D through Pd complex," as shown in Figure 1(a). D_2 gas molecules cause a dissociative chemisorption on the D_2 gas side of the Pd complex, and then D atoms diffuse toward the vacuum side, where they combine and are released as D_2 gas. We assume that the above necessary conditions are satisfied on the near surface of D_2 gas side of the Pd complex.

The Pd complex is composed of a Pd thin film, alternating CaO and Pd layers and bulk Pd, as shown in Figure 1(b). This composition was determined based on condition (i) above since the work function of CaO is relatively low (1.6 eV-1.86 eV).[2] We assume that D_2 gas permeation satisfies the conditions (ii) and (iii) above. Although the definite physical implications of the above conditions are unclear at present, it is a fact that the experimental observations described in this paper are consistent with the assumptions.

After forming a Pd complex, Cs or Sr was deposited on the surface of the thin Pd layer as shown in Figure 1(b). Permeation of deuterium through the Pd complex is attained by exposing one side of the Pd complex to D_2 gas while maintaining the other side under vacuum conditions. We perform elemental analyses of the given elements after D_2 gas permeation in a vacuum chamber. Our experimental method described above is superior in that it discriminates the products from contamination because we analyze the products in vacuum during the experiments without moving the products.

Experimental

The Pd complex is composed of a Pd thin film, alternating CaO and Pd layers and bulk Pd. A Pd plate (with purity up to 99.99%; Tanaka Kikinzoku Kogyo K.K.) was washed with acetone and annealed in vacuum (<10^{-7} torr) at 900°C for 10 h. It was then cooled to room temperature in furnace and washed with D-based aqua regia (with purity up to 99.9%) to remove impurities on the surface of the Pd plate. The surface of the plate was covered by layers of CaO and Pd (1000 Å). Then a 400-Å-thick Pd layer was sputtered on the surface of the CaO

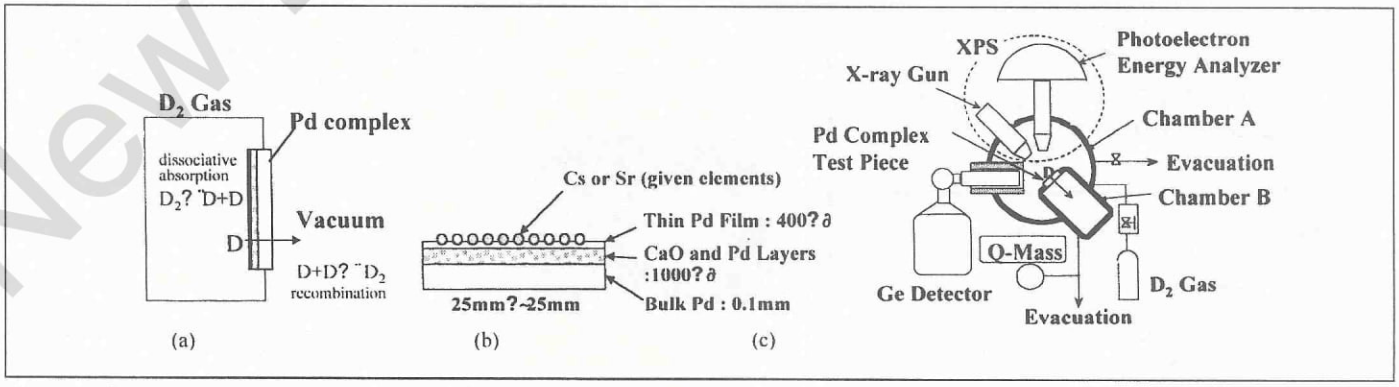

Figure 1. Schematic of the present method: (a) D_2 gas permeation through the Pd complex, (b) Structure of Pd complex deposited with Cs or Sr on the surface, (c) Experimental apparatus.

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and Pd layers. These processes are performed by Ar ion beam sputtering. Films deposited by ion beam sputtering exhibit the property of low contamination due to the low background pressure that leads to reduced gas incorporation.

After forming a Pd complex, Cs or Sr was deposited on the surface of the thin Pd layer. Cs or Sr atom was deposited by applying an electric field to 1mM $CsNO_3$ (with purity up to 99.9%) or SrOD (with purity up to 99%) solution. A Pt wire (with purity up to 99.9%) was utilized as a counter-electrode. A 1V negative voltage was applied to the Pd complex for 10 sec. Figure 1(c) shows a schematic of the experimental apparatus. One advantage of this newly developed apparatus is that we can analyze the surface of a Pd complex sample by X-ray photoelectron spectroscopy (XPS) without removing it from the vacuum chamber, thereby preventing contamination of the test sample. Another advantage is that we can detect the time dependence of the elements on the Pd complex surface. Repeating D_2 gas permeation and XPS analyses, we can obtain information on time variation of the detected elements.

The apparatus consists of two chambers, A and B, an X-ray gun, an electrostatic analyzer for XPS, a mass spectrometer and a Ge semiconductor detector. The mass spectrometer is installed for analyzing the D_2 gas permeating the Pd complex. The Ge semiconductor detector is mounted for the detection of gamma rays. The X-ray gun is non-monochro type and Al-K_ is utilized. The power is 200 W, voltage is 10 kV and current is 20 mA. The electrostatic analyzer is equipped with a five-stage electrostatic lens and the pass energy is 100 eV. The X-ray gun and the electrostatic analyzer were made in our laboratory and the energy was calibrated using Au.

One chamber (Chamber A) is filled with D_2 gas, and the other chamber (Chamber B) is evacuated by a turbo-molecular pump. These two chambers are divided by a Pd complex test piece. D_2 gas is supplied at 1 atm on the Pd film side of the test piece and dissolves in D atoms at the surface. The D atoms intrude into the Pd thin film and diffuse through the Pd complex and then reach the surface of the bulk side, where they combine and are released as D_2 molecules.

The experimental procedure is as follows. The vacuum chambers are baked sufficiently before the experiments. A Pd complex test piece with added Cs or Sr is mounted on a flange in an air environment and then introduced into the vacuum chamber. Step 1: Both of the vacuum chambers are evacuated by a turbo-molecular pump and the test piece is heated to 70°C. The ultimate pressure in the vacuum chamber was about $3x10^{-8}$ Torr. Step 2: The surface of the test piece is analyzed by XPS to confirm that no other elements on the surface of the Pd test piece are detected except the given element (Cs or Sr), Pd and C. As is widely recognized in the field of surface science, a small amount of C is usually detected on a metal surface even in the vacuum chamber. Step 3: Chamber A is filled with D_2 gas up to 1 atm so that deuterium atoms permeate from this side to Chamber B behind the test piece. Step 4: After a certain period (from two days to one week) of deuterium diffusion through the Pd complex test piece, the D_2 is evacuated from Chamber A and the surface of the Pd test piece is analyzed by XPS in the chamber. New elements that did not exist on the test piece at the beginning of the experiment can be detected. Usually this process is repeated a few times to observe the time dependence of the given or newly generated elements. Step 5: The heater is turned off and all the chambers are filled with 1 atm N_2 gas.

The test piece is removed from the chamber and its surface is analyzed by secondary ion mass spectrometry (SIMS). In this study, we analyzed the Pd complex test piece after an experiment using SIMS to investigate the isotopic compositions of the detected elements. Only surface isotopic compositions were analyzed; we did not measure their depth profiles. SIMS analysis was performed by Probion Analysis, Inc. in France using the Physical Electronics 6600.

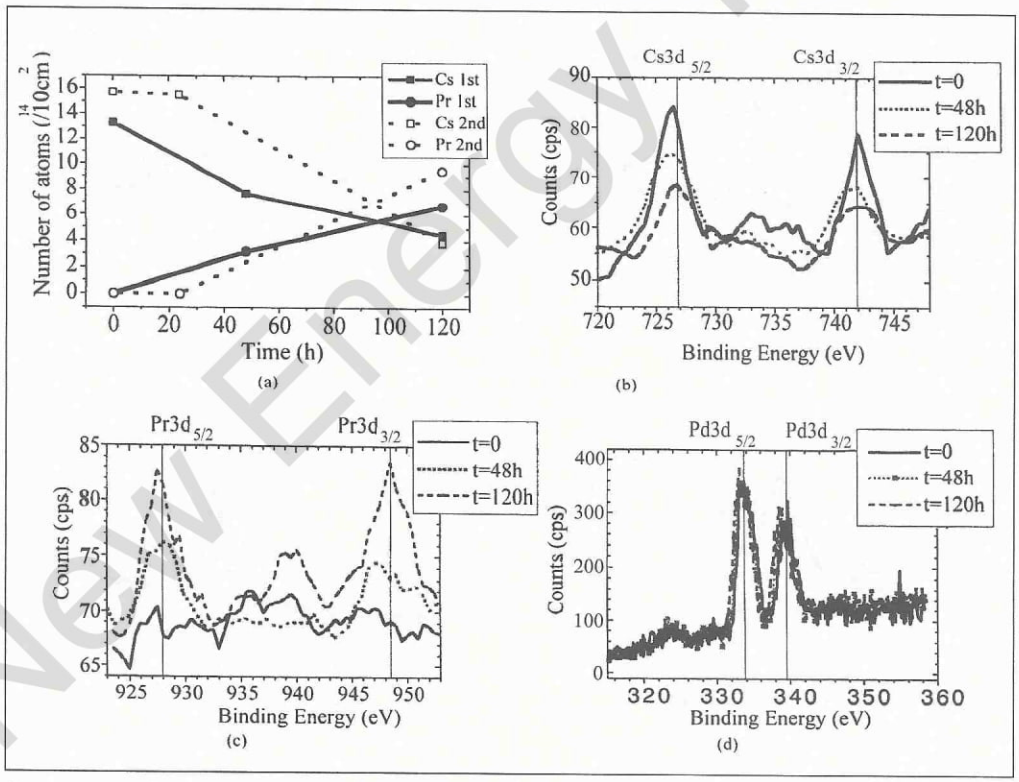

Figure 2. Experimental results obtained by D_2 gas permeation through Pd complex (Pd/CaO/Pd) deposited with Cs: (a) Time variation in number of Cs and Pr atoms, (b) XPS spectrum of Cs for experiment run #1, (c) XPS spectrum of Pr for experiment run #1, (d) XPS spectrum of Pd for experiment run #1.

Results

Experimental results are shown in Figures 2-6. During these experiments, we did not observe statistically significant gamma ray emission and gaseous products exceeding the detection limits (about 1ppm) of the mass spectrometer.

Experimental results obtained for test pieces deposited with Cs are shown in Figure 2. Figure 2(a) shows the time dependence of the number of Cs and Pr atoms. Results for two runs are shown as exam-

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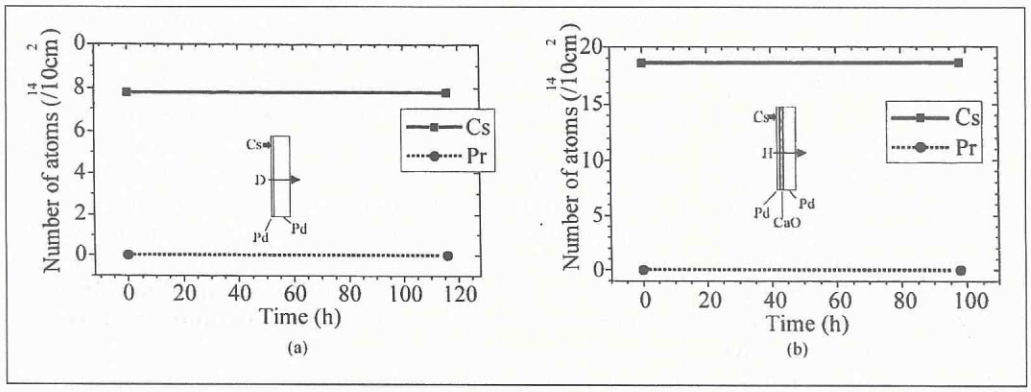

Figure 3. Results of comparative experiments using Cs: (a) Experimental results obtained by D_2 gas permeation through thin film and bulk Pd with added Cs, (b) Experimental results obtained by H_2 gas permeation through Pd complex (Pd/CaO/Pd) with added Cs.

ples. No Pr was detected at the beginning of the experiments. The number of Cs atoms decreased while that of Pr atoms increased with increasing experimental time. The amount of deuterium permeation was proportional to the elapsed time. At 120 h, the number of Pr atoms exceeded that of Cs atoms as shown in Figure 2(a). Similar results were obtained in four other runs, although the initial number of Cs atoms was smaller than that in the Figure 2(a). The reproducibility of these experiments is thought to be good.

The time variations in XPS spectra for the first run are shown in Figures 2(b)-2(d) for Cs, Pr, and Pd, respectively. All the elements are identified by two binding energy peaks[3] of $3d_{5/2}$ and $3d_{3/2}$. It is evident that the two Cs peaks decrease corresponding to the increase in Pr peaks. On the other hand, XPS peaks for Pd do not change. This demonstrates that there is no problem with the stability of the obtained XPS spectra.

In contrast, bulk Pd and the thin Pd film test piece with Cs deposition, which does not belong to a Pd complex, do not exhibit anomalous phenomena. All experimental conditions were the same as those of the Pd complex (Pd/CaO/Pd) experiments except for the formation of CaO and Pd layers. The annealing, etching by aqua regia, formation of a 400-Å-thick Pd thin film and deposition of Cs were performed in the same manner. Time variation of the Cs atom number, XPS spectra for Cs and Pr are given in Figure 3(a). It is clear Cs did not change and Pr never appeared. This experiment indicates that a CaO and Pd complex layer is essential for observing the decrease in Cs and the increase in Pr.

As a comparative study, we used H_2 gas instead of D_2 gas. The experimental results are shown in Figure 3(b). In this case, only the gas is different; the other experimental conditions are all the same as Figure 2. We also find that Cs did not change and Pr never appeared. This suggests that deuterium is a necessary factor for observing the anomalous behavior of Cs and Pr.

The experimental results for Pd complex test pieces with added Sr are shown in Figure 4. We observed that Sr decreased while Mo increased with increasing experimental time. Figure 4(a) shows the time variation of the number of Sr and Mo atoms. Experiments were performed three times and all the data are plotted in Figure 4. At the beginning of the experiments, no Mo atoms were detected, however, Mo atoms increased gradually while Sr decreased correspondingly. It should be noted that runs for Sr are required to be longer to convert Sr to Mo than in the case of Cs to Pr. As can be seen in Figure 4, qualitative reproducibility of is good. The time variations of XPS spectra for the first run are shown in Figures 4(b)-7(d) for Sr, Mo, and Pd, respectively. All the elements are identified by two binding ener-

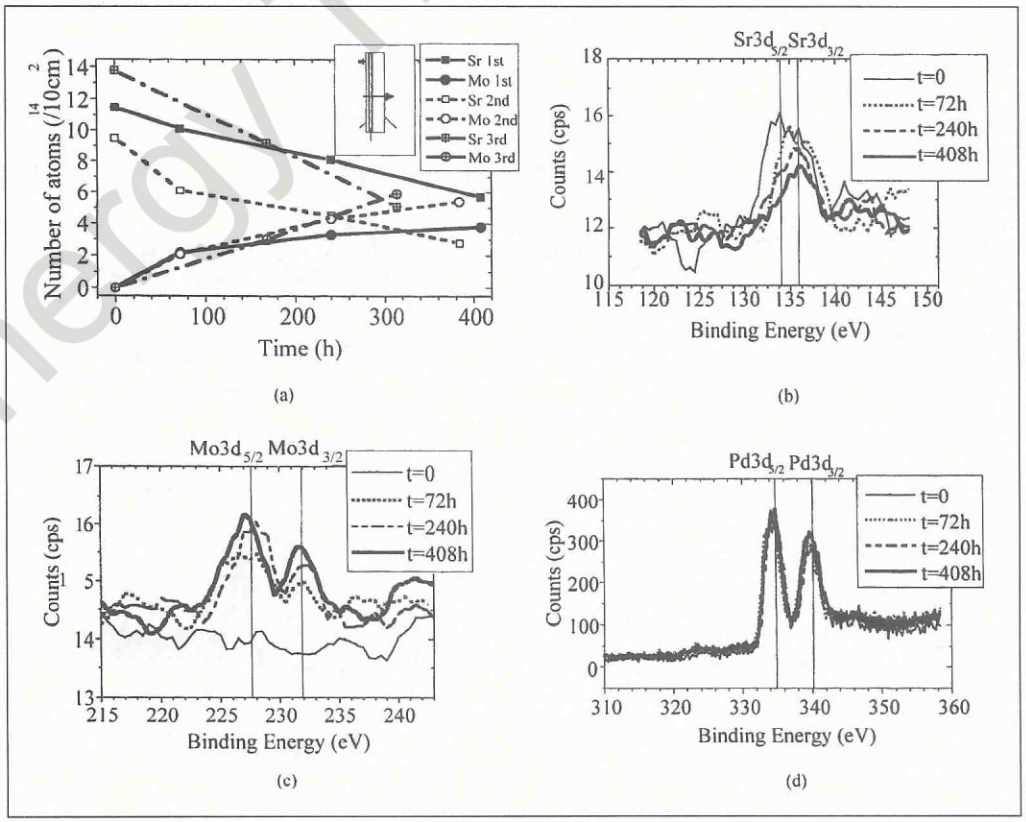

Figure 4. Experimental results obtained by D_2 gas permeation through Pd complex (Pd/CaO/Pd) with added Sr: (a) Time variation in number of Sr and Mo atoms, (b) XPS spectrum of Sr for experiment run #1, (c) XPS spectrum of Mo for experiment run #1, (d) XPS spectrum of Pd for experiment run #1.

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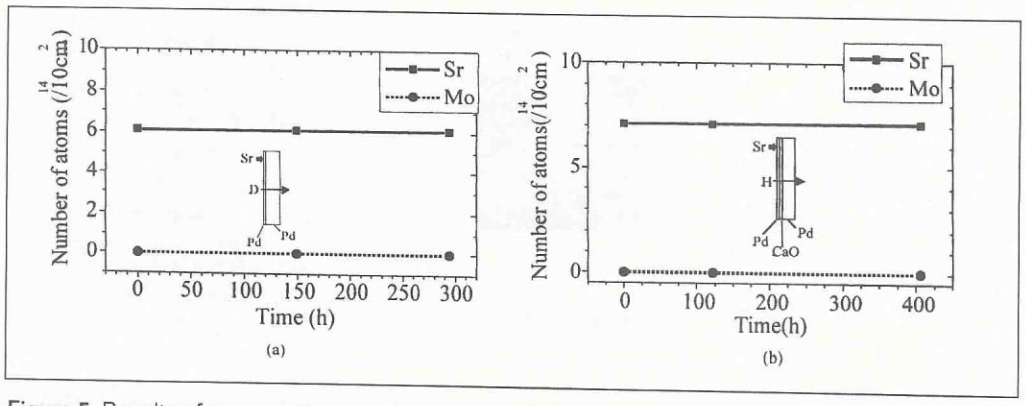

Figure 5. Results of comparative experiments using Sr: (a) Experimental results obtained by D_2 gas permeation through thin film and bulk Pd with added Sr, (b) Experimental results obtained by H_2 gas permeation through Pd complex (Pd/CaO/Pd) with added Sr.

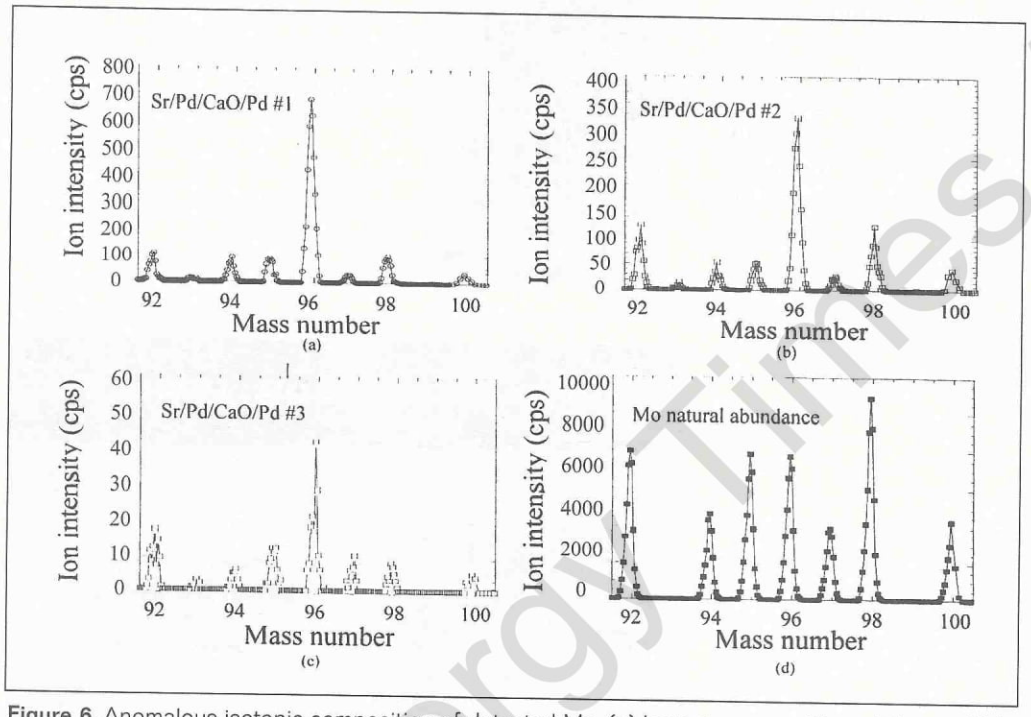

Figure 6. Anomalous isotopic composition of detected Mo: (a) Isotopic composition of detected Mo for run #1, (b) Isotopic composition of detected Mo for run #2, (c) Isotopic composition of detected Mo for run #3, (d) Natural abundance of Mo analyzed by SIMS.

gy peaks[3] in a similar way as for the Cs experiments. It is clear that the Sr peaks decrease corresponding to the increase in Mo peaks. The peaks of Pd did not change as shown in Figure 4.

Figure 5(a) shows the results of the test piece devoid of CaO and Pd layers. All conditions of this comparative experiment were the same as those of the Pd complex (Pd/CaO/Pd) experiments except for the formation of CaO and Pd layers. We can see that Sr did not change and Mo was not detected. Figure 5(b) shows the results of a comparative experiment using H_2 gas for a Pd complex test piece with added Sr. The elements on the surface of the Pd complex test piece did not increase or decrease as expected. The CaO and Pd layers and D_2 gas permeation are considered to be important factors for observing the decrease of Sr and the increase of Mo; this is the same as the case of Cs.

In order to investigate the isotopic composition, the samples after the experiment were analyzed by SIMS. Figures 6(a)-6(c) show the results of SIMS analysis for the three samples described in Figure 4. The primary ions of the SIMS analysis were O_2^+ with the energy of 5.5 keV and the intensity of 30 nA. The area analyzed by SIMS was 150 microns in diameter and mass resolution was 300. The intensities of mass number 96 were the largest for each sample, although the intensities were different. The SIMS mass spectrum for a Mo layer (400 Å thickness) which was deposited on a Pd disk is shown in Figure 6(d). This spectrum reveals the natural abundance of Mo. Comparing these figures, we can easily recognize that the isotopic compositions of the detected Mo are different from the natural isotopic abundance of Mo.

Discussion

The experimental results are summarized as follows: Cs atoms decrease and, correspondingly, Pr atoms emerge on the surface of the Pd complex by permeation of D_2 gas through it. These results were obtained six times and reproducibility was good. However, when we eliminate CaO and Pd complex layers from the Pd complex, or when we let H_2 gas permeate through the Pd complex, we observed no decrease in Cs and no emergence of Pr.

In the case of Cs experiments, the following expression can be derived, as Cs and Pr each have only one isotope.

$$^{133}_{55}Cs \blacklozenge {}^{141}_{59}\mathrm{Pr} \qquad (1)$$

It should be noted that the mass number and the atomic number increased by 8 and 4, respectively, in this expression. It is natural to consider that deuterium plays an important role in this phenomenon. This is due to the fact that Cs atoms decrease and, correspondingly, Pr atoms emerge on the surface of the Pd complex as D_2 gas permeates through it.

As indicated in Figure 4, more permeating time is necessary to convert Sr into Mo than Cs experiments. In other words, Cs is easier to change than Sr. It can be presumed that the cross sections in this low energy transmutation process depend on the type of nuclei. The observed results are expressed by the following expression because Sr and Mo

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have several isotopes.

$$Sr \blacklozenge Mo \quad (2)$$

As shown in Figure 6, the characteristic feature of the detected Mo is that mass number 96 is the largest of the isotopes of Mo for all three cases of the Sr experiments. On the other hand, the major isotope of Sr is mass number 88. This fact suggests that the following expression can explain the results of SIMS analysis.

$$^{88}_{38}Sr \blacklozenge {}^{96}_{42}Mo \quad (3)$$

It is also noted that the mass number and the atomic number increased by 8 and 4, respectively, in this expression, as is the case with Cs.

We noticed that a certain rule exists between given and produced elements.[1,4] The increase in mass number is 8, and the increase in atomic number is 4. At present, we do not have a complete theory that can explain the obtained experimental results without a few assumptions. However, if several assumptions are accepted, they are basically explained by the LENR model,[5] which is one of the working hypotheses in the investigation of the nature of this phenomenon. The observed transmutation processes belong to the new category of nuclear reactions on the metal surface associated with deuterium and electrons under low energy conditions. However, there are many issues to be resolved, especially theoretical ones, and further investigations by other researchers are necessary.

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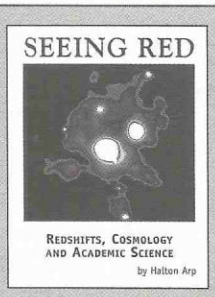

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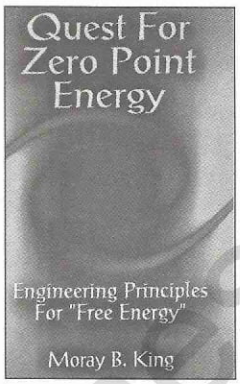

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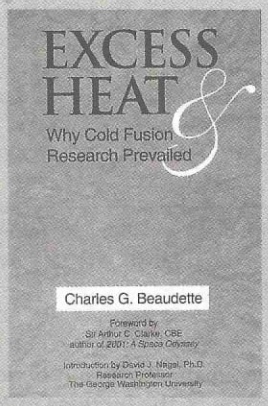

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TRANSMUTATIONS AND FUSION
Based on Ion Band-State Physics

Talbot A. Chubb*

Among the notable events occurring at ICCF9 was the presentation by Iwamura *et al.*[1] [see p. 14] of extensive research results on a cold fusion transmutation process developed by the Mitsubishi group. This group has been active for something like nine years. Their new results provide a working protocol which transmutes a surface layer of Cs-133 atoms into Pr-141 atoms. The process does not use electrolysis. Instead it uses a permeation flow of deuterium through a metal-supported layered assembly. The work was published in the *Japanese Journal of Applied Physics*.

An unrelated event at ICCF9 was the distribution of a booklet by Kirkinskii and Novikov titled, "Theoretical Modeling of Cold Fusion." This book provides an organized listing of hypotheses concerning the nature and mechanism of cold fusion. The hypotheses are grouped into categories. Among the categories are "Reduction of the Coulomb Barrier Due to Electron Screening" and "Specific Quantum Effects." Kirkinskii and Novikov also describe their own model,[2] which falls into the "electron screening" category. I responded to their work by writing them a letter that included an updated overview of the Chubb and Chubb[3] Ion Band State model, which falls into the "specific quantum effects" category. I addressed how the model describes a hydrogen-subsystem of a type specified by Chernov *et al.*,[4] and how the Cs-133 transmutation observations can be modeled within the framework of many-body ion theory.

As stated above, Kirkinskii and Novikov place the Ion Band State Theory into the "specific quantum effects" category. Scott Chubb is the theorist in our collaboration. He has pointed out[5] that, although the initial way we presented our Ion Band State Theory appears to involve a "specific quantum effect," the theory actually relates to known effects associated with the manner in which momentum and energy can be coherently shared by many particles. The underlying physics is based on the general principles of quantum mechanics that have been used to explain superconductivity, electronic structure and transport, and forms of coupling in which short-range interactions cooperatively result in instantaneous, longer range effects.

The effects that Scott identified are known to occur at low and moderate temperature, where they are referred to as spontaneously broken gauge symmetries.[5] They have become part of mainstream, conventional many-body physics. We both have argued that these effects aptly describe the $D+D \rightarrow {}^4He$ reaction.[3,5] We have pointed out that the associated framework can be used to describe many other forms of low-energy nuclear reactions. However, the arguments can become complicated. It can become difficult to identify when particular effects associated with a particular set of experiments become important. For this reason, it can become useful to rely on more intuitive arguments in order to assess the relevant physics.

An especially useful approach, in this regard, involves the use of an approximate picture based on the requirement that a quasi-equilibrium, adiabatic form of many-body interaction is involved. Scott points out that this limit is valid only under particular circumstances. My view is more pragmatic. By examining the experimental situation using the quasi-equilibrium picture, and then reinterpreting the experiment, it may be possible to gain insight into the underlying physics.

Thus, my approach is different from Scott's, and my views about how our theory is expressed reflect this fact. In this paper, I use the quasi-equilibrium approach. It is worthwhile pointing out that the adiabatic limit, which applies to the quasi-equilibrium form of nuclear interaction, is at the heart of an important prediction of both the initial Ion Band State Theory,[3] and its more refined generalization.[5] In both cases, there is a predicted absence of energetic protons and neutrons associated with cold fusion reactions. This result is based on a recognition that the required emission of energetic particles or gamma rays during a nuclear reaction is conditioned on the reaction occurring at a single point. If a many-body deuteron reaction could release its energy over a set of points, energetic particle emission would be avoided. In this regard, our thinking more or less parallels that of Julian Schwinger.

Julian Schwinger stated that "In the very low energy cold fusion, one deals essentially with a single state, described by a single-wave function, all parts of which are coherent. A separation into two independent, incoherent factors is not possible, and all considerations based on such a factorization are not relevant."[6] In our view this single wave function is a many-body deuteron wave function. In such a wave function d-d correlation-avoidance replaces the idea of a Coulomb barrier. The Schwinger statement is consistent with the previously known behavior of the two electrons of the helium atom.[7] The ground state He atom is modeled using a two-electron wave function. The amplitude of the two-electron wave function decreases to a local minimum when the two electrons are at zero separation, but the amplitude does not go to zero. The two electrons can be thought of as mutually overlapping, but anti-correlated.

In my view, Chernov *et al.* from Tomsk have identified an essential ingredient that occurs in all the cold fusion studies, seen thus far.[4] Referring to their cold fusion studies, Chernov *et al.* state: "The experimental results testify: H atoms occupy regular positions in the crystal lattice, form their own H subsystem; in this subsystem H atoms are connected with each other much stronger than with atoms of the matrix." Here, H atoms refer to either protons or deuterons. The abnormally close connection between deuterons (or protons) is a result of space coordinate exchange symmetry. It seems to me that space coordinate exchange occurs directly without coupling to an electromagnetic field when indistinguishable particles have overlapping wave functions. The individual subsystem deuterons simply lose their individuality and become merged into a quantized matter field. When

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a Chernov subsystem is a wavelike many-body deuteron system neutralized by a many-body electron system covering the same volume, it has already met the requirements for direct space-coordinate deuteron exchange. It seems to me that it has also met the requirements for dd-fusion, provided that the initial-state paired-wavelike-deuterons and the wavelike product helium-4 state are in the same Singlet nuclear spin state, and provided that the energized product state can incoherently transfer quanta of excess energy to the host matrix before the reaction is reversed. My view is that heat-producing dd-fusion reactions are made irreversible by electron scattering in the host metal. The scattering occurs because the nuclear condition affects the charge density distribution. The charge density distribution of the helium product state differs from that of the initial dd pair. This results in an electrostatic coupling between the nuclear state and the metal matrix. Overall, I view the cold fusion reaction as a perturbed stationary process whose rate is calculable by the Fermi Golden Rule of time-dependent perturbation theory. I don't view the cold fusion process as involving kinetic collisions between independent, incoherent nuclei, such as occurs with hot fusion.

The early transmutation reactions reported by many experimenters worried me. I thought that the data must be in error. I changed my view after ICCF8.[8] I now find the new Iwamura *et al.* ICCF9 evidence for transmutation of cesium-133 into praseodymium-141 to be very convincing. How can transmutations occur in accord with my thinking about dd fusion? My answer is that both dd fusion and "cold fusion" transmutations require having a Chernov-type subsystem present. In the Iwamura *et al.* experiments, there is need for a many-body wavelike deuteron subsystem to overlap with a localized cesium-133 atom. When this overlap occurs, two wavelike helium-4 nuclei produced by dd-fusion transfer their mass into the overlapped cesium atom, with energy transfers between atom and the Chernov subsystem causing dissipation of reaction energy by electron scattering.

I know that the above sounds fanciful. It requires that quantum mechanics obey previously unexplored rules when applied to a many-body ion system bound within a multiplicity of shallow potential wells. These rules are not tested when a many-body system is bound within a single potential well. Consider a Chernov deuteron subsystem containing N_d deuterons bound within a volume containing N_{cell} potential wells. It is important to model such a subsystem in terms of the degrees of freedom implicit in a system of N_d deuterons. There are three N_d degrees of freedom. Three of the degrees of freedom locate the Chernov subsystem within or on the metal matrix. $(3N_d - 3)$ degrees of freedom are internal degrees of freedom that play the same role in the Chernov subsystem as 2 rotation + 1 vibration degrees of freedom play in the diatomic molecule. Consider a periodic many-body wavelike deuterium subsystem bound to or within a finite size periodic matrix. The $(3N_d - 3)$ degrees of internal freedom are sufficient to specify the vector separations between all distinct pairs of deuterons in such a Chernov subsystem.

A specific three-dimensional internal degree-of-freedom space manifold $[R_i,R_j]$ is used to model the internal interactions involving a selected deuteron pair (R_i,R_j). This internal space manifold has the same number N_{cell} of equivalent subvolumes as characterizes the physical space within which the many-deuteron system is confined, as shown in Figure 1. Both the Coulomb repulsion interaction and the nuclear interaction are expressed in terms of the separations $R_i - R_j$ existing in this internal space manifold. Each R_i can point to a position in any of the N_{cell} equivalent subvolumes within this space manifold, and to any position within the selected subvolume. For cold fusion to occur, each subvolume must be considered to have only a $1/N_{cell}$ fraction of the integrated charge density of each of the deuterons R_i and R_j. In addition, each subvolume used in an internal energy calculation must be considered to contain a $1/N_{cell}$ fraction of the Coulomb singularity associated with the deuteron pair (R_i,R_j). Because of electron screening there is no contribution to internal energy unless R_i and R_j point to positions within the same subvolume. For small $|R_i - R_j|$ one can calculate the contribution to the Coulomb pair-interaction potential within the specified subvolume. In addition, there is an equal contribution from each of the other subvolumes within $[R_i, R_j]$. Because of the equivalence of all the N_{cell} subvolumes and because of wave function coherence, each of the N_{cell} subvolumes must contribute an equal amount of energy to the Chernov subsystem. Therefore, one must sum over the N_{cell} subvolumes to calculate the total Coulomb pair-interaction energy from (R_i, R_j). The resulting Coulomb pair-interaction energy is proportional to $1/N_{cell}$. This contribution to total system energy goes to zero in the limit of large

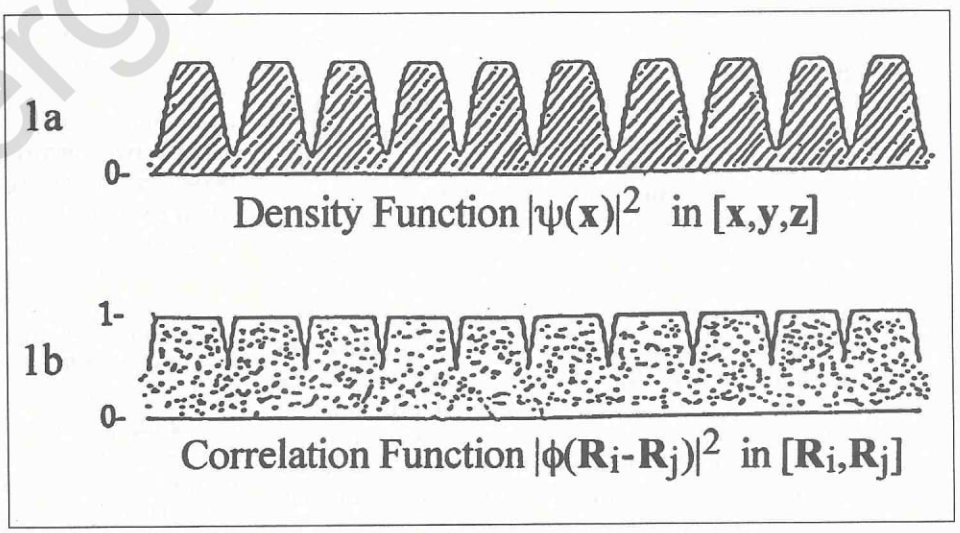

Figure 1a. A one-dimensional representation of a three-dimensional charge density distribution of a many-body deuteron system in physical space. Figure 1b is a one-parameter representation of a three-dimensional correlation function which has a dependency on the separation between two deuterons R_i and R_j. This separation occurs in an internal parameter space manifold $[R_i,R_j]$. The wave function amplitude has a local minimum in each unit cell. The amplitude of this correlation function modulates the density distribution shown in Figure 1a.

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N_{cell}. More realistically, at moderately large N_{cell} the reduced value of the Coulomb repulsion energy causes the many-deuteron wave function to replace a tunneling calculation in determining nuclear reaction rate. In other words, there exists a critical value of N_{cell} above which the many-body Chernov subsystem becomes a part of the ground state solution for the overall energy-minimized metal deuteride matrix. When this critical number is exceeded, wave function overlap occurs and fusion reactions become possible.

Applying these conjectures to the Iwamura reaction, it is assumed that whenever a deuteron is part of a Chernov subsystem, the associated point charge located in each unit cell is e/N_{cell}. In the large N_{cell} limit this point charge becomes infinitesimal. The deuteron then acts like a neutral particle with respect to interactions with a localized atom. In the case of moderately large N_{cell}, the Chernov subsystem overlaps with the nucleus of an "impurity" atom. An "impurity" atom is any interstitial or boundary atom that obstructs the wavelike density distribution of the deuteron subsystem. The combined system is described by a common wave function in which mutual overlap is reduced by correlation avoidance. This form of interaction replaces that occurring between two separate incoherent objects, which requires deuteron tunneling through the atom's Coulomb barrier. Thus, when coherent overlap occurs, Schwinger's single wave function includes both the nucleus of the impurity atom and Chernov's many-body subsystem. As a result, nuclear matter and energy can be transferred between entities. Also, it is important to note that each fusion-product ^4He remains part of the deuteron subsystem as long as it retains its wavelike form. Hence, transfer of two fusion-product ^4He nuclei to a localized impurity cesium nucleus is an allowed process. Energy flow out of the cesium atom + D subsystem is achieved by incoherent irreversible energy transfers to the host metal electrons. The dilute character of the nuclear overlap slows down the reaction time-scale relative to normal nuclear reaction times. It seems likely that the longer time-scale makes it possible for the transmutation process to select the lowest energy, *i.e.* the most stable, transmutation product.

It seems that Puska, Nieminen, Astaldi, and co-workers were the first groups to model and to create experimentally single-particle wavelike protons and deuterons on a metal.[9] I think that we were the first to use many-body physics to model a bound, finite-volume collection of wavelike deuterons (Bloch states), neutralized by many-body electrons, within a metal. This modeling applies both to periodic surface states on a metal and to periodic states inside a metal. The Ion Band State matter field seems to correspond to Chernov *et al.'s* experiment-derived picture of a proton or deuteron subsystem occupying regular positions in a crystal lattice.

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TWO-FOLD CAPTURE OF MINIATOMS
May Justify Many LENR Reactions

Lino Daddi*

In order to explain several LENR experiments, some researchers have adopted the hypothesis that a proton and an electron can form hydrogen "shrunken atoms" (hydrogen miniatoms), and similarly a deuteron and an electron can form deuterium miniatoms. Coming nearer to nuclei, the miniatoms avoid Coulomb repulsion, thanks to their neutrality; they reach a quasi-nuclear distance thanks to smallness. This is my working hypothesis.

On the nucleus, a miniatom could react in various ways: for instance, by forming virtual neutrons, as proposed by me in a 2001 paper[1] which also contains a review of about ten proposals on miniatoms. To them, the theory of Spence[2] should be added. He showed, by a QED calculation, that resonance of long life time (seconds), nuclear dimensions (fm), and low energy of formation (eV) could exist. The hydrogen miniatom, in any case, should be a neutral particle much lower in size than an ordinary atom of hydrogen: so it could cross a very thin solid thickness. [I proposed that a miniatom can turn into a neutron (p + e fusion) for a very short time, immediately before the capture by the target nucleus as a real neutron.]

On the target nucleus (characterized by atomic number Z and by mass number A) two events could happen in rapid succession, the cold fusion of the proton and the electron capture:

1) The proton of the miniatom could be captured by the nucleus (proton capture, or cold fusion by tunneling). The process is generally exoenergic; indeed this has been considered by various other authors as a possible energy producer. The formed nucleus (intermediate nucleus) is characterized by (Z + 1, A + 1) numbers; it should be of stable type, but now it is *in an excited state*. The most simple case, that we now consider, is when the proton capture is followed neither by emission of some particle (which would take a part of the energy, so subtracting it from the nucleus and giving it to the following reaction) nor by fission.

2) Soon after, the electron of the miniatom could be captured by the nucleus, as modified by Event 1. This second part of the process (electron capture by the intermediate nucleus) would be generally endoenergic, but it can happen by utilizing the left over energy from the previous reaction. The deficit value of the electronic capture could affect the probability of this event.

The closeness of approach should promote this reaction, as the K-capture is about 100 times more probable than L-capture. In the orbital captures (K and L), the electrons are available for a time which is of the order of the half-life of the transition, while they are staying on these orbitals. Remember, the capture half-lives may be short, for instance lasting some minutes. In our case the available time is very short, but the miniatom closeness could be much greater (a quasi-nuclear distance, rather than atomic distance). If the life of the nucleus excited state is long enough, the capture of an electron of different origin cannot be excluded.

The final nucleus, after the two-fold capture, is characterized by (Z, A + 1) numbers, as if a neutron were absorbed with (n, γ) reaction, but our (pe, γ) process is quite different, and the neutron cross-sections are not valid.

The total energy of two-fold capture (pe, γ) is positive, but it is less than the gamma energy of neutron capture (n, γ);

Table 1. Energies of the two captures for (pe, γ) process.

Initial nucleus	Intermediate nucleus	Proton capture $c^2 \cdot \Delta m_1$ (MeV)	Electron capture $c^2 \cdot \Delta m_2$ (MeV)	f – fraction
55 Cs 133	56 Ba 134	8.17	-2.06	0.25
25 Mn 55	26 Fe 56	10.18	-3.70	0.36
19 K 39	20 Ca 40	8.32	-1.31	0.16
19 K 41	20 Ca 42	10.26	-3.52	0.34
37 Rb 85	38 Sr 86	9.64	-1.77	0.18
37 Rb 87	38 Sr 88	10.60	-5.30	0.50
48 Cd 113	49 In 114	6.83	**spontaneous +1.43**	===
3 Li 6	4 Be 7	5.61	**spontaneous + 0.87**	===

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indeed, now the energy deficit of the proton-electron pair must be balanced. Seldom is the electron capture also exoenergic: this means that, if an electron is not captured in a two-fold process, the intermediate nucleus will undergo beta radioactivity by K-capture. In Table 1 the energies of the two captures are quoted, together with the significant ratio between the second and the first energy; when f value increases, the probability of electron capture should decrease.

Processes altogether equivalent to reactions that are different from (n, γ) reactions are possible, as fission of final nucleus should be possible. Proton capture can take place as a (p, α) reaction; if this is followed by electron capture, the total process becomes equivalent to an (n, α) reaction. Obviously the energies of the (pe, α) and of the (n, α) processes should be different.

Experimental Confirmations

In various publications, evidence may be found which confirms the validity of the two-fold capture model. Sometimes the probability of the electron capture is low, so the process may seem partial, stopping at the intermediate nucleus. In such a case the atomic number and the mass number both increase one unit. Otherwise the final nucleus is not observed, because it was not searched.

Hydrogen Two-Fold Captures

The Borghi Experiment[3] (dating back to the 1960s)

Outside the cell containing a cold plasma subjected to H.F. microwaves, various neutron detectors were radioactivated. And yet, inside the cell, neutrons cannot form (because of energy conservation and the laws of the weak force). Therefore one must think about other neutral particles, able to cross the walls of the cell to make similar effects to those of neutrons: the miniatoms.

Borghi found radioactivation of various thermal neutron detectors (among these, Dy and Au), but, surprisingly, not Mn. He deduced that the neutrons had resonance energies.

For Mn, the f-fraction is rather high; so electron capture may be unlikely. As an important check, the detector could contain instead ^{56}Fe, produced by the cold fusion of the proton.

The Borghi experiment was recently confirmed by a paper of Conte.[4]

The Siena Experiment

In the Siena experiment[5] evidence was obtained for neutron emission during energy production in an Ni-H system at about 7° Kelvin. Neutrons were detected directly by ^{3}He counters and indirectly by gold activation. The first method furnished $6 \cdot 10^3$ n/s; the latter 10 n/s. The discrepancy could be due to the inapplicability of neutron cross-sections to miniatom reactions.

Hydrogen Single Captures

The ^{133}Cs Case

Vysotskii[6] reported at ICCF9 the observation of the proton capture $p + {}^{133}Cs = {}^{134}Ba$ inside particular biologic cultures. He didn't observe ^{134}Cs formation; however, that was not sought. It is allowed by the total energy balance, but the electron capture deficit is rather high, so the further transformation of Ba by electron capture may be improbable.

Alkali-hydrogen Reactions (observed by Bush[7] beginning in 1992)

In electrolysis of potassium carbonate in light water, the nuclei of H and K pile up at the Ni cathode; calcium production is observed.

According to Bush, a cold fusion of H and K nuclei could take place, because the Coulomb repulsion is screened by the numerous electrons of the lattice and of potassium atoms. As a result of the protonic capture, he found calcium (essentially ^{40}Ca from ^{39}K). It would be interesting to verify if ^{40}K is also formed, taking into account that the f-fraction is rather low. All the same, the rarer natural isotope ^{41}K should produce ^{42}Ca, but the electron capture (until ^{42}K) could be less probable, for the greater value of the f-fraction.

Bush also observed the transmutation from ^{85}Rb to ^{86}Sr, and from ^{87}Rb to ^{88}Sr.

Other Confirmations

There are some cases in which deuterium miniatoms or minimolecules (of hydrogen or deuterium) seem to undergo a partial or complete capture.

The Deuterium Case

A two-fold capture process may also happen with deuterium;

Table 2. Energies of the two captures for the (de, γ) process.

Initial nucleus	Intermediate nucleus	deuteron capture $c^2 \cdot \Delta m_1$ (MeV)	Electron capture $c^2 \cdot \Delta m_2$ (MeV)	f-fraction
19 K 39	20 Ca 41	14.47	**0.42** spontaneous	====
3 Li 6	4 Be 8	20.23	**-13.95**	0.69
48 Cd 113	49 In 115	13.63	**-1.45**	0.11
25 Mn 55	26 Fe 57	15.61	**-2.56**	0.16

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the capture of a deuteron and an electron should be equivalent to absorption of two neutrons. In Table 2 the energies of the two captures are quoted for the (de, γ) process, together with the significant ratio between the energies (f-fraction), when the electron capture is endoenergic. Vysotskii,[8] again with biological cultures, but in heavy water, observed the $d + {}^{55}Mn = {}^{57}Fe$ reaction, at the rate of 10^{10} nuclei/s. He didn't observe ^{55}Mn formation, by electron capture, which, however, perhaps was not sought. Now recall the transition from ^{39}K to ^{41}K observed by Ohmori.[9] After the deuteron capture (that forms ^{41}Ca), electron capture also happens spontaneously, being that the mass balance is (slightly) positive. This means the transition towards ^{41}K either happens at the miniatom arrival or will follow by orbital capture (when the nucleus is in the fundamental state, with half-life of $2 \cdot 10^5$ y). Coupland[10] reported a ^{6}Li consumption in electrolysis with palladium cathode and heavy water; evidently ^{8}Be was produced. The high value of the f-fraction allows us to foresee a significant production of ^{8}Li (which, however, should again quickly become ^{8}Be).

Cluster Formation

In many LENR experiments, formation of nuclides whose mass number exceeds by more than two units that of the presumed reagent has been observed. So a simple fusion with hydrogen or deuterium may be excluded and a previous formation of "clusters" should be postulated.[11,12] Obviously, a valid bonding method must be supposed for them. According to Dufour,[13] the target nucleus could be surrounded by polarized miniatoms. But the miniatoms could form clusters in a natural manner, simply by forming minimolecules,[14] eventually of different structure compared to that of the ordinary atom chemistry; the hydrogen and deuterium minimolecules could be captured in a variety of manners (completely or not).

There are experimental correspondences; among them the important work of Iwamura,[15] which obtained the reaction from ^{133}Cs to ^{141}Cs (followed by beta decays until ^{141}Pr) by permeating deuterium gas on Pd thin films. He explained this by the absorption of clusters of dineutrons.[16] But the dineutrons are dubious particles, and a minimolecule formed by four miniatoms, fully absorbed by cesium according to the two-fold capture model, could also explain the final result.

Similarly, Iwamura observed the reaction from ^{88}Sr to ^{96}Sr (with radioactive beta decays until ^{96}Mo). It may be interesting to consider also the f-fraction of these minimolecular absorptions: the values are 0.26 for Cs and 0.30 (extrapolated) for Sr.

Another Possible Development

Between nuclei belonging to the same minimolecule, the close approach may promote the "classical" cold fusions. In particular, the p + d and d + d fusions.

Electron Detachment

A group of Chinese researchers[17] carried out an experiment consisting of a glow discharge in AC current (50 Hz) with H_2 and D_2 in low pressure (< 100 Pa). An X-radiation was measured with a Ge(Li) detector, in the range from 5 KeV to 1.64 MeV. According to the authors, the miniatoms may break up near the nucleus, so the electrons are accelerated by the Coulomb field of the nucleus, and high energy X-ray is emitted.

Comparison

Our miniatoms coincide with the hydrex/deutex shrunken atoms of Dufour.[18] But we sharply separate the proton/deuteron capture from the electron capture. The latter generally requires an excited state and has a certain probability; when it is low, only the first capture is important. We consider also the minimolecule formation, in order to explain the simultaneous absorption of many miniatoms. Dufour concludes, with particular favor, the possibility of nuclear fission events.

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The MODS Theory of Cold Fusion Can Explain Tungsten Cathode Plasma Electrolysis

David Moon*

In 1999, Jed Rothwell reported[1] on Tadahiko Mizuno's research through early June of that year. Mizuno performed glow-discharge electrolysis (plasma electrolysis) using a tungsten cathode in light water. Rothwell wrote:

> Mizuno spent several months running 100 experiments, each lasting 1000 seconds (16 minutes). He varied current density and temperature with each run. . .He found that tungsten does not produce excess heat at current density below 0.8 amps/cm^2, or above 1.5 amps/cm^2. Tungsten cathodes do not usually produce significant excess heat below 80°C. . .Even within the critical ranges of current density and temperature, some cathodes do not produce heat.
>
> After electrolysis, cathodes were washed with pure water, dried, immersed in analytical grade acetone, and placed in an ultrasonic cleaner for ten minutes. This treatment removed deposits galvanized onto the cathode surface along with a thin layer of cathode metal. An EDX spectrometer revealed formations of new elements extending below the remaining surface layers. . .However, in every case in which excess heat was generated, Si, Ca, Ti, Cr, Mn, Fe, Cu, and Zn were observed. When ordinary non-glow discharge electrolysis was performed for 1000 seconds on other samples, or when glow discharge did not produce excess heat, no new elements were found inside the cathode.
>
> The EDX analysis shows elements, not isotopes. Mizuno has not been able to investigate the isotopic distribution of the new elements yet, because they appear in small, widely scattered groups, which are difficult to find with his SIMS spectrometer.

The MODS (Mechanisms of a Disobedient Science) theory of cold fusion[2] can explain the peculiar effect of current density and other features in Mizuno's cells. The working mechanism in MODS depends on the formation of dynamic proton (or deuteron) chains in the surface layers of a metal lattice. The chains may be linear or circular vortex, as in a spinning plasma. In light-hydrogen cold fusion, close-unit proton chains have a high chance of fusion, making deuterons and excess energy in Reaction 1 below, when an oscillating chain invades a metal atom's electron cloud. In contrast, chains with protons spaced further apart will have only a slight chance of bringing fusion in Reaction 1. Instead, the leading proton in the invading chain might weakly (partially) capture an inner-orbital electron of the metal atom in Reaction 2, forming an unstable neutron, termed a neupron, n*.

$$p + e^- + p \rightarrow d + \upsilon + 1.442 \text{ MeV (phonons)} \qquad (1)$$

Where υ represents a neutrino or antineutrino. The neutrino in (1) carries away minimal energy:

$$p + e^- + E \rightarrow n + \upsilon \qquad (2)$$

where E is estimated at 80 keV.

Neuprons formed inside a metal atom can bring about transmutation of the metal nucleus, as in Reaction 3. Such transmutations produce very little excess heat, because most of the Q-value is carried out of the cell by antineutrinos:

$$_{74}W^{186} + 2n^* \rightarrow {}_{76}Os^{188} + 2e^- + 2\upsilon \qquad (3)$$

$$Q = 13.2 \text{ MeV}$$

Thermalization of beta particles (e^-) will generate UV radiation and soft X-rays.

Referring again to the data from Mizuno's plasma electrolysis with tungsten cathode, four key facts are noted: (a) excess heat occurred only between 0.8 and 1.5 amps/cm^2; (b) in every experiment generating excess heat, new elements such as Si, Ca, Ti, Cr, Mn, Fe, Cu, and Zn were observed in the deeper regions of the tungsten surface layers; (c) these new elements formed in groups or spots within the deeper surface layers; (d) when glow-discharge electrolysis did not produce excess heat, no new elements were found inside the cathode.

During glow-discharge electrolysis, the outer surface layers of the tungsten cathode cannot support close-unit proton chains because the high current densities (0.8-1.5 amps/cm^2) tend to increase the local entropy and divide the chains. A reasonable rate of Reaction 1, giving excess heat, will not occur in the outermost layers of the cathode surface. Transmutations such as Reaction 3 can occur, but these outer layers are eroded from the cathode during post-run ultrasonic cleaning.

It is interesting that when the current density was at some level below 0.8 amps/cm^2, the outer surface layers still were not able to accommodate Reaction 1 to make excess heat. As long as current density exceeds the maximum value that can allow formation of close-unit chains, fusion will be low rate or absent. In other words, the power input will be beyond what Dr. Mitchell Swartz calls the π-notch plateau, in the graph of Excess Power vs. Input Power.[3] Typically, in cold fusion, the amount of excess heat per unit power input peaks at a *moder-*

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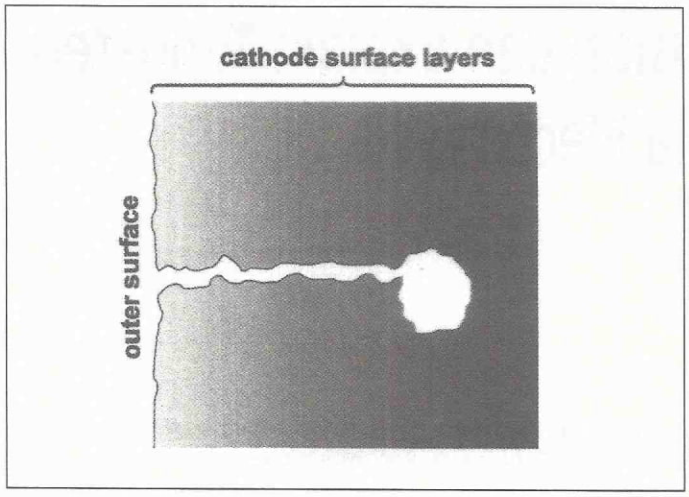
Figure 1. Lattice void with channel connecting to surface.



ate current density—when close-unit proton (or deuteron) chains are at a maximum—and falls off below or above the optimum current density.

So far in the MODS analysis of Mizuno's plasma electrolysis, it has been determined that excess heat, when produced, is produced neither on the tungsten surface nor in the outermost layers of the cathode. Excess heat is generated within the deeper surface layers. The strangest thing about Mizuno's experiments is the less than 100% production of excess heat when operating in the glow-discharge mode of electrolysis, at the required current density of 0.8-1.5 amps/cm^2.

Generation of excess heat, in these plasma electrolysis cells, occurs in the inner surface layers of the tungsten cathode, within the deeper surface layers, that later become exposed to the outside after post-run treatment by ultrasonic cleaning.

The active sites for producing excess heat in tungsten are now predicted to be subsurface (deeper surface) lattice voids or defects. Some lattice voids will have a channel connecting the void to the outermost surface, as shown in Figure 1. Other lattice voids will have no such connecting channels (Figure 2).

At the higher current applied during plasma electrolysis, hydrogen is driven deeper into the lattice surface. However, the amount of loading of the protons, spread throughout the deeper region of the cathode surface, probably is not large. The subsurface voids that are connected to the surface, however, *can fill* with protons. When a tungsten cathode has enough of these kinds of lattice voids, more hydrogen can fill the deeper surface layers. These voids are the active sites for generating excess heat. If a tungsten cathode has few such voids, or contains unconnected voids (Figure 2), little or no excess heat will be produced.

Evidently Mizuno's cathodes can accomplish filling of the lattice voids starting at a current density of 0.8 amps/cm^2. Then, enough protons begin entering these voids to form spiraling plasma vortices of protons (starting in the inside wall of the void), where the plasma core builds close-unit, circular proton chains that can trigger proton fusions in Reaction 1. Close-unit chains are possible because the effect of high current density—that of dividing chains—is diminished with lattice depth.

The fusions occurring in the plasma core energize the spinning plasma, drawing in more protons. Eventually, the plasma vortex enlarges, and builds an outer layer of proton chains, but these outer chains are not close-unit. Therefore, while fusions produce excess heat in the plasma core, protons entering the outer plasma vortex, since they are spaced further apart, can convert to neuprons in Reaction 2. A high flux of neuprons forming in this region can bring about multimodal fissions, such as Reaction 4:

$$_{74}W^{184} + 28n^* \rightarrow {}_{26}Fe^{56} + {}_{24}Cr^{52} + 2({}_8O^{16}) + 2({}_6C^{12}) + 6({}_2He^4) + 12({}_1H^2) + 28(e^- + \upsilon);\ Q = 114.2\ \text{MeV} \quad (4)$$

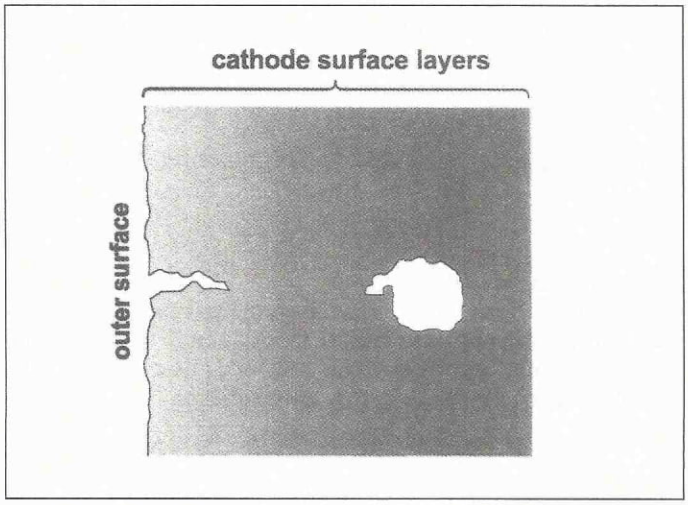
Very low cell-heating reaction; most of the Q-value is transported away by antineutrinos.

It is only when the core of the plasma vortex produces fusions in Reaction 1 that enough protons can be drawn into the outer plasma vortex to make a high flux of neuprons for bringing multimodal fission of tungsten, as in Reaction 4. In fact, as Rothwell observed concerning the Mizuno data, "When glow discharge did not produce excess heat, no new elements were found inside the cathode."

Beyond the upper limit of current density (1.5 amps/cm^2) that can produce excess heat, MODS predicts that the higher current density will cause higher entropy, that is, increased perturbations in the EM field that tend to divide the chains. Therefore, the first protons absorbed into a void cannot line up to form enough close-unit chains in the inside wall of the void. Few fusions occur in the plasma vortex, and the vortex does not develop and grow. No appreciable excess heat is generated. With essentially no fusion occurring, no additional protons are drawn into the voids. No more than a few neuprons can form, and metal transmutations are few, probably below the limits of detectability. It is also conceivable that very high current density might create conditions on the very surface of the cathode that hinder passage of protons into the lattice channels to reach the inner surface voids.

In summary, the MODS theory of cold fusion shows why excess heat, in Tadahiko Mizuno's plasma electrolysis, is produced not on the tungsten surface, nor in the outermost surface layers, but is produced within inner surface lattice voids having surface-connecting channels, and occurs within the range of current density (0.8-1.5 amps/cm^2) that allows the formation of close-unit proton chains and, therefore, a high rate of proton-proton fusion in Reaction 1. When fusions occur in these lattice voids, a flux of neuprons also will form, and will

Figure 2. Lattice void with no connecting channel.



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make new elements from multimodal fissions of tungsten.

Although the experimental data that have been discussed are three years old, good scientific data are *infinite*—like the energy they describe.

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About the Author

Mr. Moon received a B.S. from Mankato State College (now Minnesota State University) in 1972. He formerly taught high school science in Wisconsin, Missouri, Texas, and Minnesota. He currently works as a security guard in a Bloomington, Minnesota office tower, which affords him some time to "ponder the mysteries of cold fusion" between building patrols.

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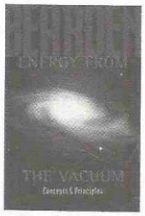

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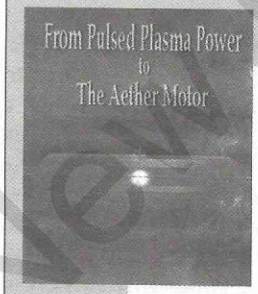

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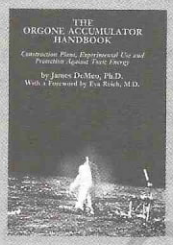

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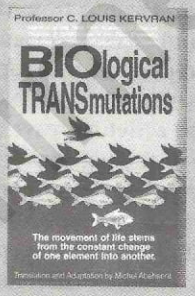

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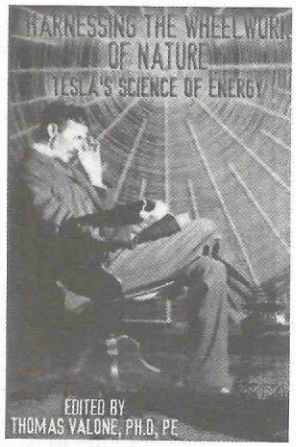

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Conference on Energy and Accountability—A BRIEF REPORT

Eugene F. Mallove

On the weekend of November 9-10, 2002, an eclectic band of new energy researchers, medical investigators, new energy entrepreneurs, and other participants convened at the Holiday Inn in College Park, Maryland to discuss science, technology, funding, and associated ethical issues. The rubric was the "Conference on Energy and Accountability" (CEA), a gathering of some 100 attendees, sponsored by the Integrity Research Institute (IRI) of Washington, DC. IRI's president and founder Thomas Valone wanted the meeting to have a "discussion format to facilitate audience participation" to consider: "Who can be held accountable? How accountable are the inventors, businesses, industries, or government?" The lively conference succeeded in provoking often heated discussions about these matters.

One of the most studied and widely verified areas of the new energy field is cold fusion or, more generically, low-energy nuclear reactions (LENR), and CEA had several speakers on this topic. Dr. Scott Chubb of the Naval Research Laboratory (NRL) spoke about "Accountability and Risk: Lessons from the Cold Fusion Furor," reviewing points he and other colleagues had made in their previously published report on this topic (see *IE* #35, Editorial). Dr. David Nagel, previously with NRL and a manager of that lab's past cold fusion activities, gave an animated talk in which he reviewed some of the highlights of the past 13+ years of cold fusion research. He was upbeat about the prospect for convincing one or more Federal research funding agencies to set aside $10,000,000 or so per year to support LENR research. I remain dubious that such funding will ever see the light of day amidst the Inquisition against this research by entrenched negativists—but good luck in your efforts, Dave and Scott! Nagel, who was previously reticent to discuss the well-known heavy-element transmutation phenomenon in LENR, was positively ebullient about it this time: "This is alchemy!" he said.

Dr. Mitchell Swartz reviewed his investigation of the atrocity that occurred at the MIT Plasma Fusion Center from 1989 through 1991, in which fraudulent data manipulation (and data *creation*!) was used to fabricate a negative result in what was actually a positive excess heat finding in that lab's replication of the Fleischmann-Pons experiment! For the first time in a public venue, Dr. Swartz termed the MIT PFC's actions, and its cover up of these actions, *fraud*—just as I have been characterizing it since 1991 (see my 55-page report about MIT and cold fusion in *IE* #24).

In part of my own talk at the CEA meeting, I briefly reviewed my conclusions about the orchestrated program of attacks at MIT against cold fusion. But the primary work I summarized concerned the aether-energy and biophysical energy sensor technologies that are being pioneered by Dr. Paulo and Alexandra Correa of Toronto, Canada. I showed excerpts from video material that appears on their newly released DVD (see www.aethera.org).

Dr. Swartz delivered another impressive talk, "Overview of Energy Medicine Suppression," which was eye-opening in its scientific scope. He illustrated how novel techniques using electricity, light, certain chemical dyes—plus radiation—have been sidetracked in cancer treatment, and how similar techniques in antiviral therapy, which he pioneered, have also been marginalized within the medical field. He gave concrete examples of successful case histories, which were astounding. It was even more depressing to hear from Dr. Swartz that one of his initial motivations for getting into cold fusion research back in 1989 was to develop a patent portfolio that could help fund his medical work! Thus, we have the suppression of cold fusion at the USPTO directly affecting the work of a brilliant medical investigator—suppression which continues with the USPTO's continued citation of the fraudulent MIT PFC work against cold fusion.

Peter Hunt, a former top aide within the U.S. Congress, gave one of the most outstanding talks at the meeting. He dissected numerous failures of the Department of Energy—and other government bureaucracies—which have led to the suppression of beneficial energy and environmental initiatives. He has promised to write an article for *Infinite Energy* about these experiences—and we will hold him to that promise. He said that most new agglomerated Federal agencies that are formed are "born senile"—especially, he said, DOE, an agency which he himself had helped form. Bravo, Peter, for your courage to tell the truth! David Hamilton of the present DOE—one of that agency's very good guys today—gave an "Overview of Government Budget Process."

This short space can't possibly do justice to the cornucopia of ideas and discussions which occurred at CEA. Professor Ted Loder of the University of New Hampshire, and his colleague Dr. Steven Greer (of SEAS, Inc., which is sponsoring the $1 million new energy Z-prize, see *IE* #46), spoke about the various levels of confusion and suppression that have attended UFO investigation, advanced propulsion technology, and new energy. Patrick Herda of Nuclear Solutions, Inc. gave an update on the status of his company's attempts to introduce a standard physics solution to the problem of nuclear waste, efforts which have been temporarily set back by the death of the company's illustrious new-energy researcher and CEO, Paul Brown. (The circumstances of Brown's death in an automobile racing accident are not completely resolved, according to statements made by Herda at CEA! *IE* will be following up on this information in a subsequent issue.)

Moray King gave an in-depth perspective on one apocryphal new energy device in his talk, "What Ever Happened to the T. Henry Moray Device." King is convinced that it was a real technology. Electrical and medical investigator Alexis Guy Obolensky, in his talk "Medical Marvels from Jumping the Speed of Light," gave us a peek at the life-and-death issues that attend the interface between alternative and conventional cancer treatments. Dr. Elizabeth Rauscher, a pioneer in many unconventional science areas, including apparently successful earthquake prediction by electromagnetic wave detection, brought down the house with her witty reminiscences about her career in both mainstream science and deep heresy.

Next year's Veteran's Day weekend conference sponsored by IRI will have a theme focused on the work of Nikola Tesla. Be there! ❑❑❑

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Space Quantum and Consequences

Alex Andrew Florey

Nonrelativistic quantum mechanics, as accepted today, is the result of a major leap in physical thinking, bringing together the modern concept of wave function and the environment in which this strange physics happens, the space-time *continuum*. The modern concept of wave function or amplitude of probability and its brilliant interpretation in statistical terms by Max Born, captured in the fundamental equation invented by Erwin Schrödinger, lives, one may argue, in an illegitimate environment based on a mathematical conjecture, *i.e.* that space is a continuum down to an infinitesimal scale. This conjecture provides us with the very foundation on which the entire edifice of differential calculus is built. This conjecture is the reason why describing the universe down to a certain scale using operatorial equations like the Schrödinger equation (where dynamic variables have been replaced by differential operators) becomes possible. A quantum mechanical model incorporating the idea of a mathematical point can result in a lot of trouble, *e.g.* the acceptance of the point-like nature of the electron, requiring the invention of an entire arsenal of tricks to brush under the carpet all the contradictions derived from such a model.

The problem could be avoided by the introduction of a concept that has been around from the earlier days of quantum mechanics in one form or another: the space quantum. The difficulty with such a concept is that a topological approach for such a space structure is a nonstarter. Heisenberg mentioned a similar idea in relation to the ultimate space interval separating two particles; he introduced the space quantum as a space segment, which is flawed in principle, because under the very hypothesis of the space quantum it is entirely forbidden to consider the other two dimensions zero. Therefore, the space quantum has to be a three-dimensional animal, a space "cell" or a "bubble"(Wheeler). This "bubble," however, has a characteristic that makes it entirely unlike our intuitive representation of bubbles: the space quantum *has to be equal in size to any of its parts*.

Space thus conceived has its structure defined not by topology but by physics. The physical concept, already in full gear, that will establish this structure for the quantized space is the amplitude of probability. If an object resides in space quantum A, there is a nonzero probability to find it at a later time in space cell B (Figure 1). Obviously, Figure 1 is entirely wrong, but it intuitively conveys the idea. So, the topological "glue" for a space structure consisting of space quantum bubbles is the amplitude of probability; clever but unnecessary questions—like, "What is between these space quanta?"—are automatically eliminated since this information is implicitly incorporated in the amplitude of probability.

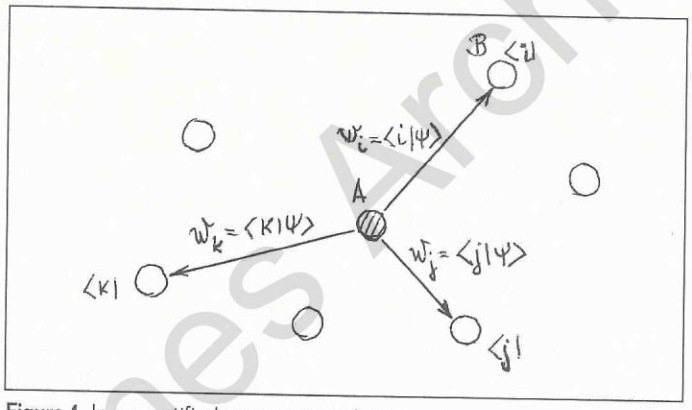

Figure 1. In a quantified space, a particle occupying a space quantum A has a nonzero chance to "jump" to a different space quantum (*e.g.* B) at a later moment. <i|, <j|, <k| are called base state vectors, w_i, w_j, w_k are amplitudes of probability (represented in general by complex numbers). A particle in space always chooses the path of maximum probability dictated by specific conditions.

This is all that one needs to press ahead and look for an analytical description of the universe using the new concept. From the very beginning one understands that equations containing space derivatives are not allowed because of obvious reasons

A quantum mechanical model incorporating the idea of a mathematical point can result in a lot of trouble, *e.g.* the acceptance of the point-like nature of the electron, requiring the invention of an entire arsenal of tricks to brush under the carpet all the contradictions derived from such a model.

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(one of them being that space in its new form is not a "domain" anymore). What about time derivatives?

The highest limit for velocities—the speed of light—suggests the existence of a quantized time interval, therefore similar mathematical problems, but for nonrelativistic phenomena, *i.e.* small velocities, time intervals become very long and can be considered continuous, so time derivatives are allowed under these circumstances.

All we need now is an equation that is only time dependent. Fortunately, such an object, called "The Quantum Mechanical Law for the Dynamics of the World," already exists and has been invented by of the twentieth century, Richard Feynman:[1]

$$i\hbar \frac{\partial w_i(t)}{\partial t} = \sum_j H_{ij}(t) w_j(t)$$

This equation is central to the tool Feynman describe successfully the hydrogen molecule, the potential between proton and neutron, the Kaon a Kaon transformation ($K^0 \leftrightarrow \tilde{K}^0$), the ammonia m many more. The tool is called Feynman's Coupl Approach. It has to be emphasized here that the physical arguments completely eliminate complicat related to the basic idea in order to get straight to the if we deal with the spin of the electron, there will be states of interest, namely spin "up" and spin "down," ter what the electron does: runs around in circles, bo gamma rays, etc. First, let us return to Equation 1 an the significance of its components.

The w_i are the so-called amplitudes of proba find a state ψ in a base state $<i|$ (*e.g.* for the spi electron there are two base states, "up" and "d state is assigned a state vector $|\psi>$ that can be wri linear combination of a suitable set of ort ($<i|j> = \delta_{ij}$) base state vectors $<i|$:

$$|\psi> = \sum_i |i><i|\psi>$$

where $<i|\psi>$ are the w_i coefficients from Equation think of Equation 1 in terms of only two base states,

$$i\hbar \frac{\partial w_1}{\partial t} = H_{11}w_1 + H_{12}w_2$$

$$i\hbar \frac{\partial w_2}{\partial t} = H_{21}w_1 + H_{22}w_2$$

Obviously, two is the smallest number for the coup approach.

Finally, let us analyze one of the unexplore quences derived from the introduction of the spa tum. Consider that under certain conditions we a situation depicted in Figure 2. The positive particle fined on the "direction" AB. We may note that ther space cells between A and B.

Classical electrostatics tells us that a positive charge in a tube, with two equal positive charges at each end, is in equilibrium in the middle. This should be equally valid for the arrangement in Figure 2. The question is: what can we call "middle" in this case? We cannot speak of a geometric middle (mathematical point). Is the "interval" AB deprived of a center? It can be immediately noticed that there are two candidates for the center, namely $<1|$ and $<2|$. Thus, Equation 3 is being assigned a very precise meaning in this case, that of the means of reestablishing the symmetry in Figure 2; particle C has equal probability to be in either $<1|$ or $<2|$ base

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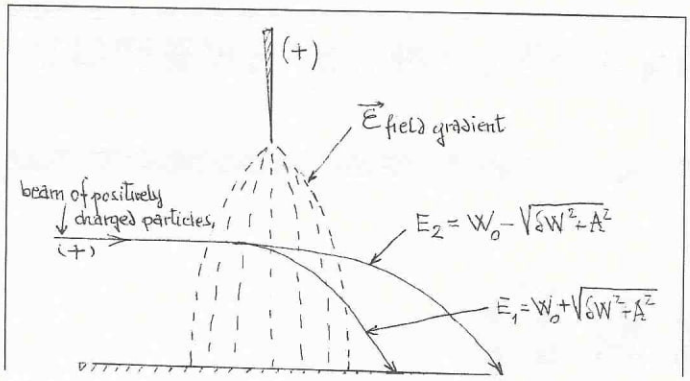
The following Gedanken experiment involves an object called a Stern-Gerlach apparatus. This device can generate, for our purposes, a strong electric field gradient (Figure 3), and will allow us to have physical access to the two energy components of a beam of positively charged particles passing between the two poles of the apparatus. We notice that the term δW in Equation 7 describes the energy change when jumping from <1| to <2| in an electric field gradient, increasing when a positive particle in the beam moves closer to the positive pole where the field is concentrated and decreasing when the particle moves away from the positive pole. As a result, the com-



ponent of energy $E_1 = W_0 + \sqrt{\delta W^2 + A^2}$ of the beam is separ- from the component with energy $E_2 = W_0 - \sqrt{\delta W^2 + A^2}$. e that because of the minus sign in Equation 7, when δW ses, the component of energy $E_2 = W_0 - \sqrt{\delta W^2 + A^2}$ ses, so the positive particle will be under attraction by *sitive pole*. The introduction of the space quantum has, esulted in an entirely new phenomenon: *an attractive etween charged objects of the same sign.*

interesting to notice that the phenomenon described in ıper (attractive forces between objects of the same elec- arge sign, repelling forces between objects of opposite charges) works for any interaction, regardless of its . It is conceivable that at space quantum distances, grav- ıld display a repelling force between masses.

re could be some interesting applications, one of them he formation of Cooper pairs in superconductors, and r is nuclear fusion and how this effect, if the space ım concept is true, could help control it.

nce

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About the Author

Mr. Florey was born in Western Transylvania (Banat), ex-province of the Austro-Hungarian Empire, in the city of Lugos, hometown to the father of the American hydrogen bomb, Edward Teller. He studied physics at the University of Temeswar and was Head Physicist in the Department of IURT (Lugos). He then defected to ary, and later migrated to Canada.

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Correction, Issue 47, p. 30

In Issue 47 of *Infinite Energy* magazine, the paper by Alex Andrew Florey ("Space Quantum and Consequences," pp. 29-31) contained a misprinted figure. The image in Figure 2 (p. 30) was a duplication of the one in Figure 3. The Figure 2 caption was correct, but the image was not correct. Reprinted here is the correct Figure 2 image, and the accompanying caption.

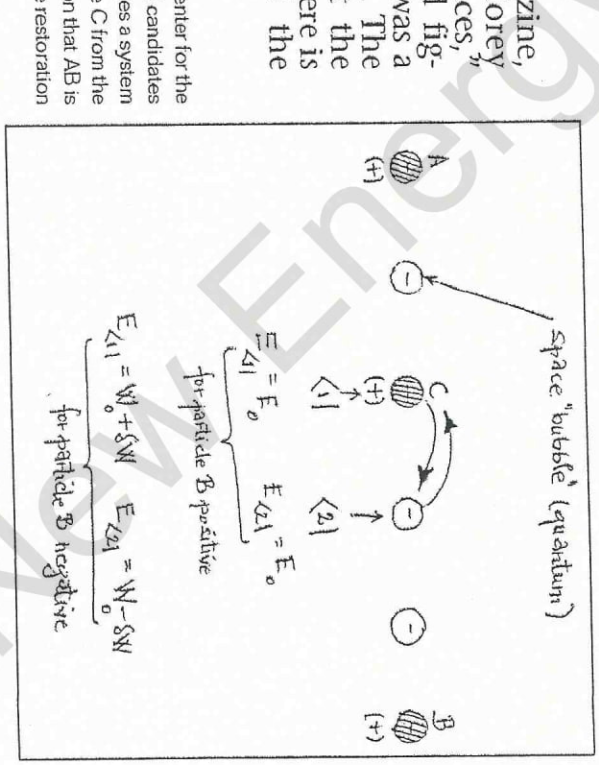

Figure 2. In a situation like this, there is no conventional center for the "interval" A-B. The two positions, <1| and <2|, are equal candidates for that function, therefore the system in this figure becomes a system with two base states, <1| and <2|. If we remove particle C from the system, the asymmetry would persist, raising the suspicion that AB is a two base state system solely for reasons of principle (the restoration of symmetry).

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DOMED If You Do. . .

Jon Norris*

Despite the ill-informed pronouncements of some people that energy conservation is not an important part of our energy picture, it is actually one of the most vital portions of any plan to use energy wisely. Increasing the efficiency with which we use energy is not only a core philosophy in almost all design science, it is more cost-effective in the long run, and it frees up resources for greater use. It is a real head-scratcher for anyone with the slightest functional brain capacity to ponder why anyone would argue against doing more with less. Maybe it has something to do with who actually pays the tab and who profits from inflated energy rates?

Fortunately, most people are smart enough to understand that lighting your house with compact fluorescent bulbs for one-third the energy cost of incandescent bulbs is a smart move. So, for those people who do understand the importance of saving energy, I offer another nifty energy saving concept to consider—the concrete monolithic dome.

The building industry is hardly known for its cutting-edge, envelope-pushing design strategies. If anything, this sector is known for being very slow to innovate, and even slower to accept new ideas that represent more than simple variations on a well-worn theme. This retrograde mindset is also driven by bankers and others in the financial end of the business who consider buildings as investment material, not as shelter. They want everything pushed to the middle of the bell curve to maximize investment potential. Also, there is the taste of the buyers to consider, but that is heavily influenced by the designers, builders, and financial sectors.

Since energy used to light, heat, and cool buildings is such a significant portion of our collective energy bill, it would stand to reason that people would be interested in designs that save as much energy as possible. Seems like a good idea, but the reality is a bit more disappointing.

There have been many attempts to design more efficient structures by such talented folks as Luigi Colani and R. Buckminster Fuller, among others. Many may be familiar with Fuller's geodesic dome and the benefits of the spherical shape where materials and energy use are concerned. Briefly, the dome shape encloses the greatest volume with least surface area and materials. This means that you save on materials and that there is less surface area to conduct heat. There are also some interesting convection effects created by the shape that can be helpful in heating and cooling the enclosed space, depending on the floorplan.

Fuller's lesser known Dymaxion House concept grew out of aircraft design. While round, it was not a dome nor geodesic. It was designed to be easy to manufacture and erect; it was made with many interlocking panels. No component weighed more than ten pounds, and it could be assembled easily. One was actually built and used in Kansas. The experiment was moderately successful, but ended with that one home.

Geodesic domes faired somewhat better, becoming something of a cultural icon for the Boomer generation. There are still many companies offering plans and kits to build geodesic domes, and they maintain a strong niche of popularity.

Geodesics are generally still built of wood products, like conventional rectangular buildings, and are subject to all the same problems of those materials. However, there is a variation on dome construction that is gaining popularity. This is the concrete monolithic dome.

The idea is the brainchild of two brothers, Randy and Barry South, in collaboration with Dr. Arnold Wilson, an expert on thin shell construction. In going back further into Fuller's design inspiration, the concrete monolithic dome is more like an egg in that it ends up as a continuous shell instead of an assembly of parts with lots of edges and joints that can fail and leak.

The process that the South brothers have evolved over the last twenty years is fairly simple and straightforward. A tough balloon, or "airform," is created in the shape and size desired for the final structure. A foundation of concrete is poured at the site, and the airform is attached to the foundation. Using large blowers, the airform is inflated. Entering through an airlock setup, the crew then sprays the inside of the airform with two layers of polyurethane foam insulation, embedding special connectors in the foam. A cage of con-

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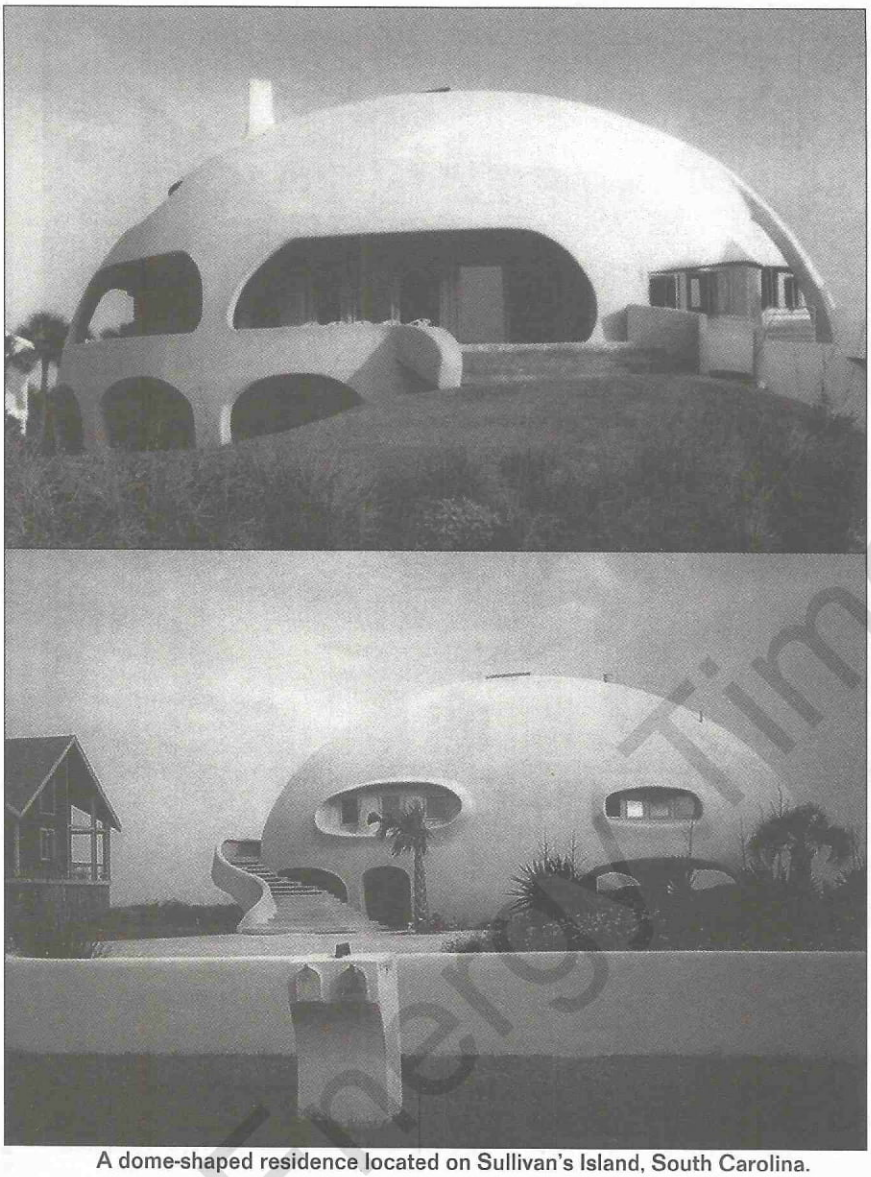

A dome-shaped residence located on Sullivan's Island, South Carolina.

Photos courtesy of the Monolithic Dome Institute.

crete reinforcing bar, "rebar," is built next, attached inside the structure with the special connectors. Several layers of a concrete mix, called shotcrete or gunite, is then sprayed over the rebar cage until it is at least three inches thick. The shotcrete is allowed to cure and the blowers are removed when the curing process is done. The outside of the airform can then be covered with concrete, stucco, or roof coatings. Window and door spaces are planned for ahead of time, and are not sprayed with concrete. When finished, one has a shell over six inches thick, with concrete on the inside, covered on the outside by a thick layer of foam insulation and the vinyl airform. The finished shell is earthquake, tornado, hurricane, fire, insect, and rot proof. The interior space is clear span, although load bearing walls can be added for multiple stories. These structures are also very quiet inside.

The resulting structure is incredibly energy efficient. The walls have a minimum insulating value of R-60. The concrete interior of the shell serves as a thermal mass, which helps maintain an even temperature inside the dome. Large structures can save 35% or more on materials cost, and some dome owners have documented heating and cooling energy savings of up to 75%! How would you like to cut your heating and air-conditioning bill by 75%? What would you do with that money? How would the decreased demand effect energy prices if significant numbers of new buildings were this efficient? One of my favorite examples given to illustrate the significance of this kind of energy savings is how investing the money saved on energy cost can actually pay for the building over the life of the mortgage, even using interest figures as low as 7%. Maybe we should take 5% of the hot fusion budget to finance concrete domes? I think the benefit to the public would be significantly higher.

One also saves money by using much smaller heating and cooling equipment, because the dome will require one-half to one-third the capacity of a regular structure of similar square footage. Fire insurance costs are also drastically reduced, not to mention the danger of fire itself. If the interior walls are made of steel studs and sheetrock, the only thing that can burn is your furnishings! Imagine the savings not only of building resources, but personal belongings too. Fire costs our society a tremendous amount every year in terms of money, materials, and lives lost.

There is also a great deal of freedom and creativity in designing this kind of dome. According to Rick Crandall, the primary architect working with the South brothers, virtually any shape that can be inflated can be built. Of course, the more one departs from the true sphere or egg shape, the more one has to compensate. Stronger rebar placed more closely, along with thicker layers of concrete, increases costs. There are many interesting designs shown on the Monolithic Dome website (www.monolithicdome.com), and some of the domes have been featured on television.

Sounds like a really exciting idea, doesn't it? One would think that people would be knocking down the doors of the South brothers' business. Well, while these domes are steadily gaining popularity, many people just don't seem to

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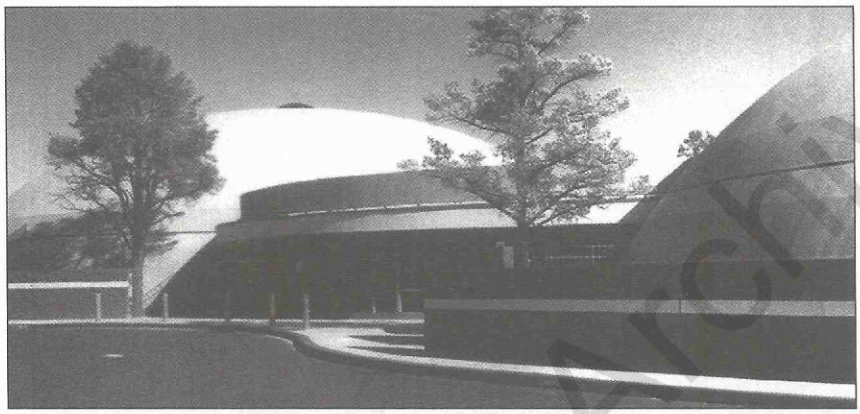
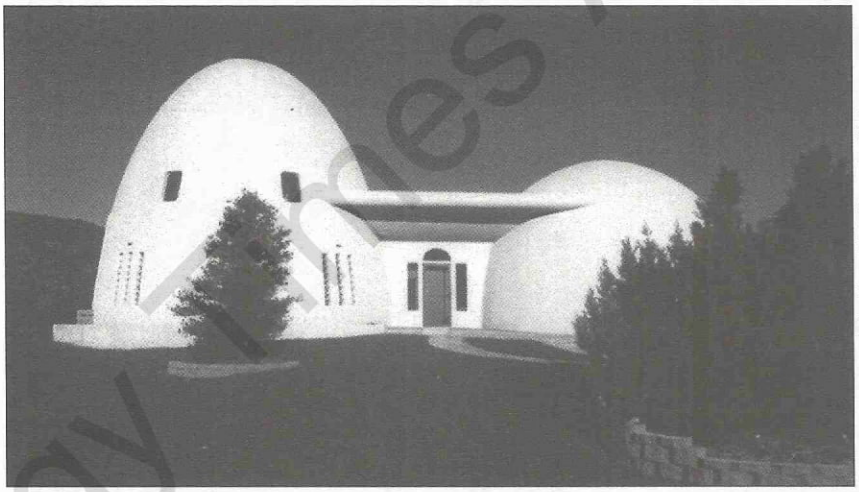
be able to get past the "round" part. Square is what they've been used to, and square is what they understand. Also, unusual houses are actively discouraged by builders and lenders, and people are afraid to risk innovation when such large amounts of money are at stake. I have attempted to interest many people in these designs, including a small university and our local city government. Despite the massive monetary savings possible, the domes were never given more than a cursory dismissal, and I still get snickers and "that dome guy" remarks. As a taxpayer, that makes me angry. However, the economic interests involved and the mindset of those in power can make real innovation nearly impossible, regardless of the benefits. (None of that in the cold fusion arena, is there?) Humans are not rational creatures, and it is hard to convince some that it is not still the fourteenth century.



A domed elementary school.



Xanadu, a dome house in Sedona, Arizona.

Photos courtesy of the Monolithic Dome Institute.

As is so often the case, new ideas are difficult to convey to many people. Most people dislike new and different ideas, and despite the common impression that Americans are all "rugged individualists," the reality is that most people want to blend in with the crowd. There are very few people who truly want to step out of the pack. As Fuller pointed out, it is that "one percent" of the population who innovate that makes the human race a success.

Fortunately, there are growing numbers of people who care enough about their own lives to search for the best technologies available for their homes and offices, and the number of people discovering monolithic domes is increasing every day. After nearly half a decade of researching building technologies ranging from modified refrigerator truck trailers to luxury submarines, I would rather live in a concrete dome than anything else. I have a thick file with the designs I have explored for myself, and I fully intend to build one to enjoy for the rest of my life.

Who knows, maybe you will be the next person bitten by the dome bug. For further information, visit these very informative websites:

❑ www.monolithicdome.com ❑ www.zdomes.com ❑ www.buildart.com ❑ www.domeofahome.com

About the Author

Jon Norris is a twenty-seven year veteran of the telecommunications industry. He began his study of anomalous data and fringe science in the late 1960s after exposure to John Campbell's editorials in *Analog*. He is currently the team leader of a teleproduction facility at a small university. Mr. Norris continues to comb the fringes of science for valuable information.

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ECLECTIC OBSERVER

Compiled by Eugene Mallove

Revolutionary Scientific Paper on a Solid-State, Macroscopic Maxwell Demon

Professors of physics and mathematics at the University of San Diego have published a remarkable scientific paper, "A Solid-State Maxwell Demon," (*Foundations of Physics*, Vol. 32, pp. 1557-1595, October 2002, www.kluweronline.com). The paper by D.P. Sheehan and A.R. Putnam of the Physics Department and J.H. Wright of the Mathematics and Computer Science Departments proposes a laboratory testable, solid-state Maxwell demon that uses the electric field energy of an open-gap p-n junction semiconductor device to drive a solid-state mechanical piston. The authors used numerical results from a commercial semiconductor device simulator to verify their analytical model. They describe the proposed device as a "thermally rechargeable capacitor which, in this incarnation, is used to power a linear electrostatic motor."

They write, "Present day fabrication techniques appear adequate for laboratory tests of its principle. . .Prospects are good for laboratory construction and testing of this solid state Maxwell demon in the near future [the authors project within five years]. . .It seems plausible that experimental tests of this solid state challenge to the second law may be on the horizon."

The authors and their colleagues have a little-known publication record on Second Law of Thermodynamics challenges, which dates back to the mid-1990s. They write, ". . . the present challenge appears to be the first to propose both the second law's *potential violability* and its *actual violation* under everyday thermodynamic conditions." They mince no words about the implications of their work: "The steady-state operation of this solid-state electrostatic motor constitutes a Maxwell demon; that is, it is a perpetuum mobile of the second type." In other words, it is possible to make a macroscopic perpetual motion machine of the second kind, which uses the ambient heat (and *no* lower-temperature reservoir) to generate net mechanical power! If this work holds up and the device is actually built, one of the most fundamental pillars of modern physics (make that "Fizzix") will collapse in deserved ignominy. Good riddance!

The authors project that such electronic devices should be able to convert heat energy directly into work with high instantaneous power densities, perhaps greater than 10^8 watts per cubic meter! The Sheehan *et al.* article is a *must read for all pioneers in the new energy field*! Sixty references are cited, including the First International Conference on Quantum Limits to the Second Law (San Diego, July 2002) and a book to be brought out in 2003 by major academic publisher (Kluwer Academic, Amsterdam), *Challenges to the Second Law of Thermodynamics*, in the "Fundamental Theories of Physics" series.

In view of the DOE's generally negative stance against paradigm-breaking physics, it is with some irony that we note that the work was, in part, supported by a DOE grant. Furthermore, breaking the infamous Second Law with a macroscopic energy generating device is actually a far more profound challenge to the physics establishment than the threat from the already proved, but mostly ignored, low-energy nuclear reactions (LENR) field.

The Evan Ragland Advanced Physics Laboratory

Infinite Energy received an announcement for the dedication of The Evan Ragland Advanced Physics Laboratory at Mississippi State University, in a ceremony that took place November 13, 2002. The newly dedicated laboratory will be part of the Department of Physics and Astronomy within the College of Arts and Sciences at the University. Evan Ragland of Diamondhead, Mississippi, a long-standing researcher in the cold fusion field, was awarded this honor for his association with and contributions to Mississippi State University.

Evan Ragland's work with triode-type Fleischmann-Pons cells was profiled in *Infinite Energy* (#10, pp. 22-24). An excerpt from the brief biography that appeared with that article: "Born January 7, 1927 in Greenwood, Mississippi, Evan Ragland seems always to have had an affinity for high tech electronics and computers, with a special genius for solving problems. . .After Navy service in World War II and after graduating from the U.S. Navy Electronics School, he earned a BS degree in electrical engineering at Mississippi State University in 1949. . .In 1962, Ragland was elected to the advisory council to Motorola's board of directors. . . During his long career, he has collected eight U.S. patents, most of them pioneering concepts in computers and electronics—ranging from the Daisy Wheel Printer developed for the U.S. Signal Corps, whose original is now in Washington's Smithsonian Institution, to the wipe-through reader of credit cards and digital-to-voice devices that form the basis for telephone answering machines."

"The Quest for Clean Energy Must Begin Now"

The New York Times ran a story (November 1, 2002, p. A8) by Andrew C. Revkin, with the banner, "Scientists Say a Quest for Clean Energy Must Begin Now." The article reported the conclusion of a group of "diverse" scientists and engineers in an article in *Science* (November 1, 2002, "Advanced Technology Paths to Global Climate Stability: Energy for a Greenhouse Planet," pp. 981-986) that "a research effort as ambitious as the Apollo project to put a man on the moon" was essential to meet increasing global needs for clean energy, in light of the threat of global warming.

"A broad range of intensive research and development is urgently needed to produce technological options that can

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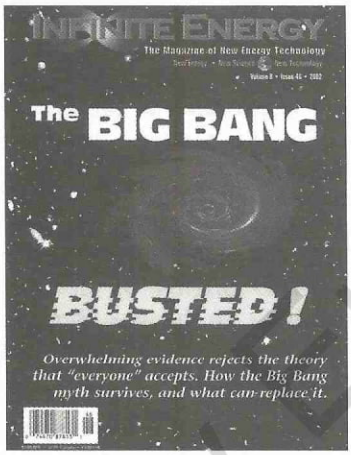
allow both climate stabilization and economic development," the group of eighteen investigators wrote in *Science*. Among other recommendations, there was a call to develop technologies such as hot fusion reactors and space-based solar power plants. Revkin wrote: "In interviews, several of the authors and other experts said there were few signs that major industrial nations were ready to engage in an ambitious quest for clean energy." He quoted Kert Davies, research director of Greenpeace, "Techno-fixes are pipe dreams in many cases. . .The real solution is cutting the use of fossil fuels by any means necessary."

Neither the scientists performing the study, the Greenpeace activist, nor Revkin himself appear to have the vaguest inkling that truly *new energy* solutions exist for the problem they were addressing. Such willful ignorance of new energy prospects is likely to prevail until a crushing intellectual blow is delivered to the business-as-usual scientific establishment.

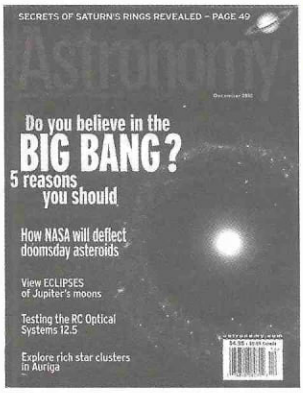
Astronomy Magazine Affirms Big Bang

Infinite Energy's "The Big Bang—Busted!" cover story of last issue (*IE* #46), is sharing space, side-by-side on newsstands with *Astronomy* Magazine's December 2002 issue, which has the glaring message, "Do you believe in the BIG BANG? Five reasons you should."

Astronomy Editor Dave Eicher remarks in his supporting editorial, "Big Bang Brouhaha": ". . .the Cosmic Microwave Background Explorer satellite and other experiments have nailed down fundamental observations that the Big Bang would explain. Yet for some reason, a non-trivial slice of the scientifically-literate public seems hesitant to accept the Big Bang as fact. It's even become fashionable to doubt the entire concept's validity, despite the supporting evidence for it, because all the details of how the resulting early universe evolved aren't known yet." Eicher says that we should have as much confidence in the Big Bang as "in the next sunrise." Hmm. . .



Astrophysicist Jim Sweitzer's feature article in *Astronomy*, which gives five supposedly strong reasons to believe in the Big Bang, cites those very lines of evidence with which most Big Bang antagonists find major flaws! See Dr. Tom Van Flandern's listing in *IE* #46 of the major problems with Big Bang "evidence." Sweitzer writes, "As theories go, the Big Bang ranks close to Copernicus's notion—now accepted as unshakable fact—that the Sun, not Earth, is the center of the solar system."



According to National Science Foundation surveys, apparently only 33% of the American public accept the Big Bang—and this is 5% fewer than prior to 1990. Yes, Inquisitioners of the scientific establishment, it is very hard to fool all of the people all of the time, and you apparently can't even fool *most* of them with the Big Bang. Maybe the average citizen suspects a rat when the physics know-it-alls claim to have nearly in hand the final "theory of everything," which mandates that "everything" (including "space-time") came from absolutely "nothing."

Hot Fusion Money Heist Afoot

The hot fusion community is orchestrating another major looting of the U.S. Treasury, as it tries to persuade Congress and the Bush Administration to rejoin the infamous $10 billion (now a svelte $5 billion) ITER (International Thermonuclear Experimental Reactor) program. If it doesn't get that, the hot fusioneers' back-up plan is to push for something called "FIRE"—"Fusion Ignition Research Experiment," a U.S.-based tokamak plan. But hold on, a new number has appeared! Now in "only" thirty-five years the magnetic hot fusioneers promise to deliver a "practical" hot fusion electric power generating plant. The number that had been bandied about *for the last half century* was thirty to fifty years for that power plant. There must be some perceived PR value to "thirty-five years," because it certainly cannot come from any analysis that would withstand scrutiny. This new number is said by one DOE bureaucrat to be driven by "environmental needs."

We read in *Physics Today* (November 2002, pp. 28-29) that on September 11, 2002—an appropriate date for a disastrous event—the DOE's "independent" Fusion Energy Science's Advisory Committee (FESAC) strongly endorsed a recommendation of its "Burning Plasma Strategy Panel" (BPSP) that the U.S. should "negotiate" to rejoin ITER. The price for rejoining, it is said, is a cool up-front $100 million and thereafter $100 million/year. "A $100 million here, a $100 million there, and soon you'll be talking real money," as the joke goes. But this is no joke; it's for real.

As in most Federal science boondoggles, panels are asked to approve the recommendations of other panels. In this case, FESAC (which had earlier accepted the BPSP recommendation) had briefed a National Research Council (NRC) panel for two days, asking for its recommendation! Off on the sidelines, DOE's Office of Energy Science head Ray Orbach was so enthusiastic about the prospective money coup that he asked the NRC panel to get him its report with unusual speed (by early December—almost before the last of the Thanksgiving turkey had been downed), so that he "could use it to support his case that the U.S. should rejoin ITER." A site for the piggish monstrosity is to be selected in 2004; can't let the Canadians, Japanese, Europeans, or Russians have any unfair advantage in siting, can we now? Besides, who wants to have learn Japanese or Russian!

Here is the key line in the *Physics Today* article by Jim Dawson: "Orbach [of DOE] said the FESAC and NRC burning

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plasma reports will be central to a decision by President Bush on whether to rejoin ITER negotiations." Listen up you out-in-the-cold cold fusioneers and new energy purveyors: You can't get any Federal money on your own, so maybe you should plan to get into bed—so to speak—with some of these savvy hot fusioneers, and learn how to tap into the new money stream. Grab some while the grabbing is good. Anne Davies, DOE's top hot fusion bureaucrat, for one, is hot to trot, according to *Physics Today*: ". . .I think we're absolutely ready to build a burning plasma experiment." She's such a knee-jerk fossil cheerleader for hot fusion that almost no one can remember when she began her career in hot fusion scamming. She'll tell ya how to do it! You might also ask Dr. Miklos Porkolab how to get some cash, since he's in on the money frenzy too. Yes, that's really his name, and he heads the MIT hot fusion lab. How poetic!

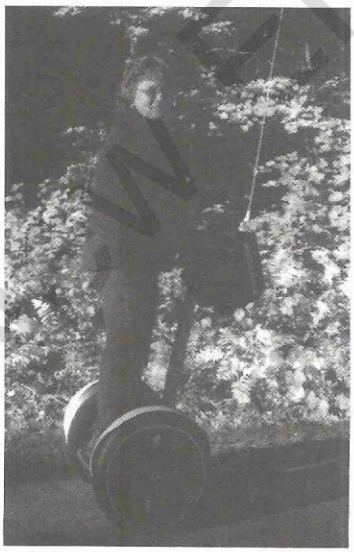
Oil Spill Off Spanish Coast Recalls March 24, 1989

The breakup (and later sinking) of the oil tanker Prestige off the northwestern coast of Spain on November 13 has already spilled an estimated 2.7 million gallons of fuel oil from the Bahamas-registered ship, whose hull cracked in a storm. This has caused a caustic "black tide" to swamp Spain's scenic coast and seriously damage the country's fishing industry. It is also a reminder of the 10-million gallon Exxon Valdez oil spill off Alaska's coast just after midnight on March 24, 1989—an event that occurred, ironically, less than twelve hours after Drs. Fleischmann and Pons made their cold fusion announcement in Utah on March 23.

The Prestige broke in half and sank November 19, about 150 miles off Cape Finisterre, taking the remainder of its 20 million-gallon cargo of "black gold" to the ocean floor. This oil will likely continue to be a threat for a long time.

The Things We See on the Road!

When you are driving, it pays to have your camera at hand. In mid-October I gasped in amazement upon seeing my first Segway, in-the-flesh; it was cruising down a country road in Pembroke, New Hampshire, not far from my home. No, this was not a mail delivery person or an electric meter reader in transit. The lady in command of one of Dean Kamen's creations was simply out for a spin and having some fun. I stopped to introduce myself and get permission for the shot. The woman turned out to be the wife of one of the Segway engineers. The company apparently gives good employee discounts for its expensive mobile wonders. We non-employees can now buy Segways via the web (see www.segway.com); the cheapest model is now a cool $4,950.



A few days later, I found myself behind a New Hampshire-registered RV ("recreational vehicle," for those who don't speak North American English). The "Infinity" logo reminded me so much of our magazine's banner, that I decided to find a good spot to shoot the lumbering craft. It was much less elegant than the Segway, but it will probably be a lot more comfortable in the approaching New Hampshire winter. In the New Energy Age, that logo might really mean something—"infinite energy-powered," perhaps. And, there will be no Exxon station to spoil the view of the turtles sunning themselves on an exposed rock in the pond by the roadside. ❐❐❐

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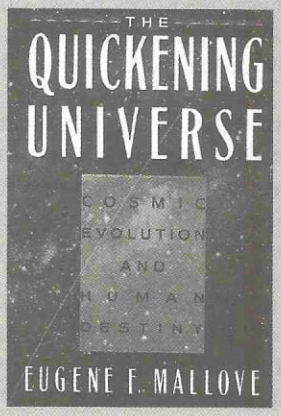
The Quickening Universe:
Cosmic Evolution and Human Destiny
by Dr. Eugene F. Mallove



286 pp., Hardcover, 1987

$10.00 North America / $15.00 Foreign

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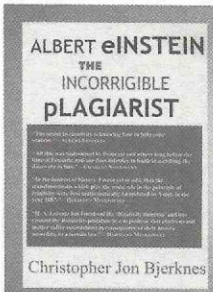
Book Reviews



Albert Einstein: The Incorrigible Plagiarist

by Christopher J. Bjerknes
ISBN 0-9719629-8-7
$19.95 Paperback, 408 pp.
XTX Inc., 2002

Review by Thomas E. Phipps, Jr.

Hagiophobia is defined as "a morbid dread of holy things." There is no question that the author of this book, Christopher Jon Bjerknes, is an exemplary sufferer from this too-rare complaint. For in our time Albert Einstein has been sanctified. . .perhaps even above Albert Schweitzer, who certified the holiness of all living things, himself included. Einstein's life having been told and retold by numerous hagiographers, Bjerknes has made it his aim to provide the market with equally numerous anti-hagiographies—this being apparently the sixth he has written. The publishers have burdened the latest with a disclaimer, "This book is intended solely for entertainment purposes." However, we all know that nothing entertains better than a good character assassination.

For this purpose the book employs the Socratic method, the asking of loaded questions—in the style of, "Was this man ever known to stop beating his wife?" Physicists, who lead the pack of Einstein idolaters, will dismiss Bjerknes' questions with contempt. But I think others will be impressed, if nothing else, by the sheer doggedness of the scholarship that has gone into the bibliography. This fills almost half the book and comprises 567 numbered endnotes, some of which stretch for more than a page and include extensive references to the literature. Among these notes will be found almost anything that has been written by or about Einstein or his ideas, to the present date. My own limited scholarly resources noted only one omission: Karl Popper, the philosopher who first (?) linked the names of Einstein and Parmenides, is absent. But Parmenides is here, as he amply deserves to be.

From the start we note a deep schism: the author would like to side with feminists who see Einstein's work as actually done by his much smarter first wife Mileva; but, since Bjerknes also wants to paint that same work as stolen from earlier investigators, he faces an abiding problem of whose character to assassinate. Here the Socratic method proves a life-saver: Rather than offering a definitive choice, he provides weaponry for assassinating both Albert and Mileva, and leaves it to the reader's political preference, an open question, which candidate to take as the priority target.

Given all this smoke, how much fire is present? Einstein (or Einstein-Marity, the first wife) stands accused primarily of "plagiarism" in respect to the basic ideas of the special relativity theory. Narrowly construed, *plagiarism* refers to the copying of an earlier author's published words. No such charge can be laid against Einstein. The author exhibits not a single instance of word-copying or what the litigious would term copyright infringement. But that is not what Bjerknes means. He is referring to the theft of ideas without acknowledgment. Here the case is much stronger and also much fuzzier. Einstein's 1905 paper (which—amazingly—was originally submitted to *Annalen der Physik* under the name Einstein-Marity, according to the first-hand account, cited here, of Abram Joffe) contained not a single reference to earlier work. This is frowned on in modern science, and should have been challenged by the editor even then. For Einstein would have been a poor scholar, indeed, if he had failed to read Poincare's prior work on relativity, which explicitly enunciated the Principle of Relativity. One can understand omission of any reference to the much earlier work of Wilhelm Weber, who developed the first and last *relativistic* formulation of electrodynamics in terms of relative coordinates, velocities, and accelerations—since such would have directed attention to the persistence of absolutist elements within "special relativity" theory. (The "observer" or "frame" is such an element—a *tertium quid* extraneous to the intrinsic elements to be described in nature, and wholly absent from Weber's theory. Minkowski's covariant symmetrizing of the *quid* among all its quiddities alleviates, but does not eradicate, this echo of absolutism.)

Another dilemma of the author in respect to special relativity is whether to concentrate his attack on the theory itself or on its creator. If the theory is no good and was in fact stolen by Einstein (or by Mileva) from predecessors, then its would seem the blame for this no-goodness should fall most heavily on the latter. Error plagiarized is not error sanitized. Its provenance aside, Bjerknes clearly distrusts the special theory (as does the present reviewer); but the book makes little serious contribution to the comparatively vast (though little known and little regarded) literature of its logical criticism.

Einstein's (or Einstein-Marity's) originality consisted in adjoining the Poincare relativity principle to the Maxwell equations (which contain only one field propagation velocity parameter c and thus *necessitate* what we now call "Einstein's second postulate") and in showing that these stark logical ingredients suffice to imply a kinematics based on the mathematical coordinate transformations that Lorentz had already spelled out. Clearly the ideas pre-existed. But, as all inventors know, it is not permissible to patent ideas. If the combining of pre-existing ideas in new patterns is to be called "plagiarism," then it would not be an overstatement to say that all scientific progress and all invention depend on just this kind of plagiarism. . .for what did Newton do but plagiarize from the giants on whose shoulders he acknowledged standing? He neglected only to attach names to the giants. So did Einstein. In both cases the behavior was perhaps a trifle magisterial. . .and also perhaps more than a trifle forgivable. Still, unpleasant doubts persist in the Einstein case: Bjerknes shows that Einstein's scientific publications reveal a lifetime pattern of similar magisterial behavior. The absence of attributions in the 1905 paper was not a one-off occurrence. For example, I quote from page 231 of the book: "David Hilbert, on whom Einstein went calling for help, published the general theory of relativity

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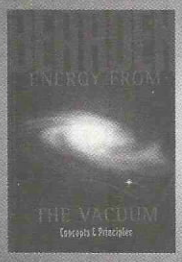
before Einstein. Why after many years of failure, did Einstein suddenly realize, within a few days after David Hilbert's work was public, the equations which Hilbert published before him, and then submit his, Einstein's, identical formulations?"

As you can see, this last (stripped of its Socratic question mark) constitutes a genuine charge of plagiarism. . .but it is not backed by chapter and verse citation, equation number by corresponding equation number, word by word. Lacking such substantiation, the charge cannot stand in court. In law, equations, like ideas, cannot be copyrighted or patented. Still, here is more smoke. It is doubtful if all such can be permanently cleared away. But one would like to see scholarship comparable to that of Bjerknes applied to the task. Otherwise, a polluted atmosphere and a bad odor linger.

In conclusion, I recommend the book to Einstein scholars and to sociologists of science as a genuinely valuable bibliographical resource for further research on the man and his times—and as a target for the Einstein hagiographers to shoot down if they can. Other readers, in search of more than entertainment, must proceed with caution.



Energy from the Vacuum: Concepts and Principles

by Thomas Bearden
No ISBN Assigned
$95.00 Paperback, 951 pp.
Cheniere Press, 2002

Review by Eugene F. Mallove

This is a weighty book, literally and figuratively. It's 951 pages display the collected and synthesized wisdom of the author's three decades of experience in the new energy field. It is a marvelous compendium of one man's struggle to come to grips with the physical theory that may underlie a host of claimed over-unity devices and processes, including, yes, "cold fusion." Bearden and four of his colleagues are known for their U.S. Patent #6,362,718, "Motionless Electromagnetic Generator," which was issued March 26, 2002 and is assigned to Magnetic Energy Ltd., Huntsville, Alabama. The book includes a 35-page section on this device alone, complete with photographs. The author states that J. Naudin in France (and others "who did not wish to publish their results") have independently replicated the MEG. Activities are underway to commercialize the technology. (The company's CEO is Dr. James L. Kenny.)

The author dedicates his opus magnum ". . .to those lone researchers and stalwart inventors who have succeeded in building working model COP>1.0 electrical systems in the face of overwhelming odds and strong scientific opposition. We particularly mention Gabriel Kron, T. Henry Moray, John Bedini, Jim Watson, Ed Gray, Frank Golden, Floyd Sweet, Howard Johnson, Ken Shoulders, Bill Fogal, the Correas, and Teruo Kawai."

The author's outpouring of writing followed a heart attack in the spring of 2001, which made him ". . .realize the absolute necessity of passing the 'energy from the vacuum' information and baton, so to speak, to those sharp young graduate students and post doctoral scientists who are interested in this area. They simply must not have to spend the thirty years of their lives getting to this point. Instead, they should start where I am now, correct any errors I have inadvertently made, and go much farther."

Indeed, it is quite probable that Bearden's complete thesis may be wrong in important particulars, and even in some aspects of the fundamentals of extracting energy from the "vacuum state." Regular readers of *Infinite Energy* know that I have become familiar with the hands-on *experimental* and theoretical approach toward a general reformation of physics taken by Dr. Paulo and Alexandra Correa, whose science and technologies build on the work of N. Tesla, H. Aspden, and W. Reich. Bearden's work must be viewed as a more direct extension and reformation of electromagnetic descriptions, so in some sense it will be more immediately comfortable and accessible to those who have already explored the flaws in EM theory and relativity. (It must be noted, however, that Bearden himself does not take issue with Einstein's Special or General relativity theories, and in fact says that "active local curvature of spacetime" is involved in over-unity processes.)

I can't imagine, as one example, how Bearden would propose to explain the thermal anomaly that is to be found associated with Faraday cages and ORACS ("orgone accumulators" in Reich's terminology), or a host of allegedly "electrostatic" phenomena, which appear to be vacuum state (*i.e.* dynamic aether-related). Of course, there can be only one true physics of the universe, yet it is very valuable to have at least two overarching descriptions of new energy physics on the table at the same time. There are no doubt areas of compatibility, as well as areas of deep inconsistency. This is to be expected, for in many ways the present crisis in the foundations of physics—unadmitted by the establishment, of course—demands that there should arise several fundamental explanations of the massive absurdities and evident incompleteness that is part and parcel of modern, dogmatic physics.

Apart from its foundational work in physics, and its descriptions and assessments of several still-in-dispute over-unity devices and processes (the latter filling 165 pages, excluding treatment of the MEG), Bearden's book has other features which make it well worth acquiring. It has 100 pages of endnotes and valuable references, many of them clearly of significant import but not very well known; a 73-page well-executed index; and a 128-page "Annotated Glossary of Selected Terms." That leaves a 607-page body, a 27-page introduction, and 35 pages of appendices for bashing conventional thermodynamics, which comprise the main body of Bearden's work. The book is not without its endearing repetitions of basic arguments and opinions, but important ideas do bear repeating.

Bearden's thesis is radical and based on his determination that physics has taken several very wrong turns in its treatment of electromagnetism. He concludes: ". . .one can understand why conventional EM systems and circuits do not develop COP>1.0 or self-powering, even though all the energy collected and used in every electrical power system comes from the vacuum and not from the shaft energy input to the generator, chemical energy dissipated in a battery. . .or

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from the water power dissipated in a hydro turbine." Moreover, he writes, "Neither classical thermodynamics nor classical electrodynamics deals with the transduction of time-energy into spatial energy in a system, which is a totally different type of energy exchange accomplished by charge." And, ". . .as the present laws of classical thermodynamics are stated in the textbooks, *every charge and dipole in the universe already violates those laws, and has done so since the beginning of the universe.* Let us put it bluntly: Every charge in the universe already freely and continuously pours our EM energy in 3-space in all directions, without any observable EM energy input. That is the well-concealed source charge problem, known but ignored by the leaders of the scientific community for a century. All EM fields and potentials and their energy come from those source charges, according to electrodynamics itself."

Bearden continues his summation, "Either we must give up the conservation of energy law entirely, or else we must accept the fact that unobservable *virtual* EM mass and energy are continuously absorbed from the vacuum by the source charge, transduced into real observable EM energy, and then re-radiated in 3-space in all directions as observable EM energy, creating the associated fields and potential reaching out across the universe. That this problem continues to be ignored by the scientific community—some 45 years after the basis for its solution has been proven and is well known in particle physics—is totally inexplicable. But it continues to be resoundingly ignored, which means that *the scientific community itself is and remains totally responsible for the energy crisis and the associated vast despoilment of the biosphere, because it adamantly insists on using a seriously flawed electrical energy science whose hoary basis is more than a century old.*" This would also be an apt model for an indictment of the scientific establishment over the past fourteen years, for its behavior with respect to the cold fusion/LENR discoveries—using a probably seriously flawed nuclear and atomic model to attack experimental evidence.

Bearden charges that present electrical power systems are ". . .unwittingly designed and constructed by engineers to deliberately destroy the source of that enormous energy flow from the vacuum faster than the system can use some of it to power its load." Fortunately, there *are* demonstrations of incipient technology and scientific phenomenon that break those design rules! As Bearden wryly puts it, "It only takes one white crow to prove that not all crows are black. . .It is high time that our electrical power engineers and scientists heed the message of all these demonstrated white crows of nature, and begin developing and deploying self-powering COP>1.0 electrical power systems with alacrity." As one who has witnessed several such "white crows" firsthand (see www.aethera.org), I heartily agree.

What is the nexus of the problem that standard EM has missed, according to Bearden? He describes "perhaps the greatest scientific faux pas in history": *"There is not now, and there never has been, a single electrical engineering department, electrical engineering professor, electrical engineering textbook that teaches what powers an electrical circuit. Yet the basis for it has clearly been in particle physics since 1957, as certified by the award of the Nobel prize to Lee and Yang. What powers every electrical circuit and system is the broken symmetry of the primary system's source charges and source dipole (i.e. the broken symmetry of the opposite charges on the ends of the dipole) in its fierce energy exchange with the seething vacuum, once that dipole has been made. The modern 'charge' is also a dipolarity, once its associated clustering virtual charges of opposite sign are considered. Further, any dipole will freely extract EM energy from the vacuum, convert it into real energy, usable, observable EM energy, and pour out real, usable EM energy continuously and indefinitely, so long as the dipole remains intact."*

It is impossible for a review of this brevity to explore the particularities of Bearden's massive tome. It is an intellectual feast that will have to be digested over time. It does have its blemishes. I noticed that no mention was made of the experimental or theoretical work of Drs. Peter and Neal Graneau, an unfortunate omission. And, though I understand Bearden's intention not to become involved in an all-too-predictable shouting match with Joseph Newman, it would have been appropriate for Bearden to have rendered his opinion on that inventor's famous EM device. I remain puzzled by some references in the book to claimed events concerning direct acts of intended harm to inventors from dark forces. I cannot judge them, other than to acknowledge their possibility. The "dark forces" of the public stance of establishment science and its media lackeys, and the slings and arrows from misguided "friends," have been quite enough to impress *me* with the difficulties in this field!

Bearden concludes, "A single 200 million dollars of good research in EM energy from the vacuum would solve the energy crisis forever, and dramatically reduce the pollution of the biosphere. The scientific community will spend many times that amount on their favored 'big science' projects, but not one cent on EM energy systems powered by energy extracted from the vacuum." He is very right about the misdirection of the scientific community, but most certainly wrong about the order of magnitude of funds necessary to solve the energy crisis forever. In my view, on the order of $10-$20 million put into producing a robust, pre-production prototype self-sustaining 5- to 10-Kw generator from any of a number of such candidates would do it. But even such pathetically small sums of money (compared to the reward expected) are not easily found in a world that simply does not "believe" in the possibility of free energy. Corporations and governments much prefer "business as usual," and there are no enlightened megastars of the financial and philanthropic world (*e.g.* Bill Gates, George Soros, Ted Turner) who apparently have any intention of taking free energy seriously. Still, there may be one "white crow" among them, and so the search goes on! Bearden's book, and other such probing exposes of the failure of establishment science, will be lasting testaments to "what could have been." ❐❐❐

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Our Challenge: An Editorial from the Natural Philosophy Alliance (NPA)

Francisco Müller, NPA President

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After five days of intense lectures and discussions at a workshop this summer in the Canary Islands, I realized that we still lacked a sense of unity and direction of our efforts as a group. The variety of topics covered and the diverse ways in which each of the participants interpreted them could be a source of dismay, if one failed to recognize that's precisely the environment encouraged by NPA. Some topics were the priority of energy over force as a physical reality (defended by Peter Marquardt), or the opposite viewpoint (Johann Marinsek). Or, the relative character of all rotational phenomena defended by Andre Assis versus its absolute nature defended by others. Or even, the amount of relativistic "facts" that can be accepted as valid (Ron Hatch), or as plainly false (Hector Munera). Or, as explainable by alternative theories (many others). One (Neil Munch) argued it is best to fully define the problem before seeking its solution. This variety of viewpoints created some good debates among us, both openly or during the continued discussions at coffee breaks or at the restaurants. All of this, of course, was constructive and a sign of the vitality of the participants—indeed, a successful aspect of the meeting.

But certainly this is a sign that, at this stage of our efforts, we cannot expect concurrence of opinions, much less total agreement in all issues. In fact, the healthy variety among our ranks guarantees that if all of us are not 100% correct at least some might be on a good track. And, if collaboration continues on a friendly and open basis, these "right track" efforts will finally coalesce into two or three strong lines of development.

This, then, is what I wanted to stress as a final comment to the Canary Islands workshop: We need to somehow find some common ideas and conclusions which can "unify" us, if not totally at least in those partial problems and some topics. George Galeczki tried, in similar fashion, to propose some short, clear cut statements against relativity that everybody would accept. On my part I proposed, for future work at the NPA meetings, to establish some "sub-division" of topics, or some "regional" meetings convoked to tackle some very special problem in contemporary Physics. No specific propositions, however, have yet been implemented.

It seems that the only "unification" I could, and still can, describe at the moment is an "intentional" one, *i.e.* we all want something to change in contemporary physical science. If not, we would not have attended this workshop. But the nature, content, extent, and timing of this change is still in the dark. As a challenge, I proposed the idea, at the opening section with Francisco Gonzalez Redondo (our host) that the year 2005 should be a sort of "deadline" for us. That year marks the 100th anniversary of Einstein's special relativity theory (1905) and the 50th anniversary of his death, (1955). This coincidence "tempts" us to aspire to see the "death" of the theory while we mourn the death of its author. But of course, nobody would accept any change if it is only the "death" or "dead-end" of a theory. A new one is absolutely necessary. If anything is clear in Thomas Kuhn's familiar book, *The Structure of Scientific Revolutions*, it is that no revolution has occurred nor will occur in the future unless there is a proposed alternative theory to replace the older one. The human spirit can not progress only by negative thoughts. It needs the positive food of truth, the elevation to new syntheses and visions of older and newer realities. Hence, it remains a challenge for all of us. So, I am asking all NPA members, "Are there any questions or theories upon which a majority of us can converge and coalesce. . .by the year 2005?" Let us hope so.

And if so, how do we reach that agreement and get that message to the scientific community?

Send your suggestions for a problem or a paradigm on which a majority of us might agree to: Francisco Müller (fjmuller@bellsouth.net) or Neil Munch (nemunch@cs.com). Please keep explanations simple. ❑❑❑

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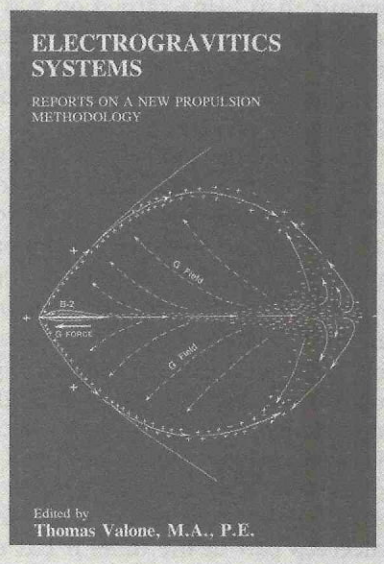

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Cold Fission and the Vortex Theory:

"COLD FUSION" IN LIGHT OF MIZUNO'S DATA

Arnold G. Gulko*

Tadahiko Mizuno's 1997 book, *Nuclear Transmutation: The Reality of Cold Fusion*, presents some reliable data revealing the nature of the aqueous electrolytic fusion process[1] which employs heavy water supplying deuterium ions which are electrolytically loaded into a palladium cathode. This data allows this writer to expand on the mechanism of cold fusion described in *Infinite Energy* #40, where he suggested the production of helium could be explained by the combination of deuterium, a small amount of fractional hydrogen, and a captured neutron supplied by the palladium cathode or by some addition thereto, such as boron.[2] It will be understood that the formation of helium by neutron capture did not preclude the formation of some tritium, again by the capture of a neutron supplied by the palladium cathode.

This writer has been convinced since the spring of 1989 that excess heat provided by the cold fusion experiments then being carried on was the result of the deuterium loaded into the palladium cathode capturing a negatively terminated neutron on the nucleus of an atom situated in the cathode of the system. This would produce tritium.

Palladium used as the cathode in the early cold fusion experiments carries such neutrons, and if a neutron were captured and removed from the palladium nucleus, this would destroy the palladium as a source of such neutrons. Since other elements, such as boron, also carry the needed neutron in a much smaller nucleus containing fewer deuteron-repellent protons, he filed a prophetic patent application in which boron was incorporated within the palladium cathode of the known aqueous electrolytic cold fusion system.

One of the problems of cold fusion is the difficulty of reproducing it consistently, and Mizuno states it only succeeds part of the time. It has recently been found, as this writer predicted in 1989, that the incorporation of a small amount of boron into the palladium cathode enhances the cold fusion interaction, greatly increasing the success percentage.[3]

Cold fusion evoked excitement, because it appeared to provide a simple and largely non-radioactive route for causing deuterium to fuse with itself to provide energy, but this writer never agreed. This is partly because the fusion of deuterium with itself was not the likely source of the heat produced in the cold fusion reaction for the simple reason that if deuterium fused with itself, the neutron emission from that reaction would have killed those who carried out the reaction in the absence of heavy shielding, and that shielding was not present. Yes, some cold fusion theorists claim that the Pd lattice makes this neutron radiation non-operative, but I do not agree with these concepts.

When a deuteron captures a neutron and removes it from the palladium nucleus, several things happen, some of them good and some of them, like the damage done to the palladium, not so good. Back in 1989 this writer had no clue as to how the palladium would respond to this rather significant damage, but Mizuno's careful work reveals the facts, as will be discussed.

The capture of a neutron by a deuteron forms tritium without producing helium-3 and without emitting large numbers of neutrons. Such a reaction is manifestly more practical than the deuterium-tritium high temperature fusion now being investigated by various governments at enormous expense. This writer assumed in 1989 that large amounts of tritium would be formed, and many of the early reports did indicate that tritium had been found. At that time he had no idea hydrogen could exist in a fractional quantum state, as has been claimed by Dr. Randell Mills.[4] It is stressed that the capture and removal of a neutron on the palladium contained in the cathode is very different from the deuterium-deuterium fusion some thought was being carried out.

Mizuno's quantitative finding of only small amounts of tritium in the aqueous medium and his finding of palladium

In the vortex theory, the fission of palladium induced by the removal of one of its neutrons will preferentially form iron, chromium and copper, exactly as found by Mizuno in the used palladium cathode.

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transmutation products in cathodes following the generation of excess heat in cold fusion systems demand that we more carefully consider the results now available to see if they can be explained. Mizuno states at page 65:

> We found 3 x 10^{11} atoms of tritium. Total neutrons produced over the course of the experiment was about 4 orders of magnitude lower, roughly 106 to 107 neutrons. . .Comparing the numbers as a whole, the first thing that strikes you is that with ordinary D-D fusion the ratio of neutrons, tritium, and joules of heat would be $1:1:10^{-12}$, but the ratios derived in this experiment were $1:10^{4-5} : 10^{-1-2}$. Tritium production was 4-5 orders of magnitude larger than conventional fusion. Heat was 12-13 orders of magnitude greater. This result completely bewildered us.

So in ordinary deuterium fusion, which demands enormous temperatures and confinement, every two fusion events releases one neutron, forms one atom of tritium, and hardly any heat (10 to the minus 12 power joules is minuscule). In contrast, for each neutron released in the cold fusion reaction, one obtains from 10,000 to 100,000 atoms of tritium instead of only one. These facts demand that neutron release and tritium production in cold fusion have little to do with one another because too few neutrons are released to connect them with the substantial amount of tritium formed. The only other rational source of tritium production is the neutron capture concept which this writer has long insisted upon, and it will soon be seen that Mizuno's transmutation data strongly supports this concept.

Since deuterium-deuterium fusion is ruled out because there are far too few neutrons to account for the tritium produced, one can explore the question of whether the heat produced is related to the tritium produced. But this possibility is also ruled out by the facts. This is because the heat produced per atom of tritium formed is about a trillion times greater than when deuterium fuses with itself, and roughly a million times greater than suggested by the mass defect per atom of tritium formed by cold fusion.

Accordingly, when deuterium is converted to tritium, energy is released because the tritium atom contains less mass than the total of one deuterium atom and one neutron. The energy released by tritium formation is a direct function of the mass lost. However, cold fusion produces a million times more energy per tritium atom formed, so tritium production is only a tiny side effect of whatever is producing the heat. Moreover, neutron production is only a tiny side effect of that tiny side effect. Mizuno's data forces these conclusions.

Mizuno's book further establishes that strange elements containing fewer protons than palladium are found near the surface of the used cathode, and especially since these elements contain unusual isotope distributions, we have a strong suggestion that something has forced the palladium nucleus to break apart in a fission event to provide these strange elements.

Fission is a response to excess energy in a nucleus, and fission normally produces only a few elements in large amount. Here, excess energy is provided while either tritium or helium is formed, and the formation of either tritium or helium from deuterium demands the addition of a neutron. The prime source of a neutron is the palladium nucleus, so the formation of tritium or helium provides excess energy which could flow into the palladium nucleus as the energy content of the neutron was restored to enable its release. The formation of only a few elements in large amounts is uniquely provided by nuclear fission, and this aspect of fission will be discussed shortly.

Let us examine the fission of palladium from several different perspectives, first from the standpoint of the large amount of heat released. We start by assuming that one fission is provoked for every atom of tritium formed by cold fusion and that the fission involved releases 100 times more energy than is released when tritium is formed. But the previously quoted data establishes that cold fusion produces far more than 100 times that obtained by the formation of tritium. So while more energy may be provided by fission than by the formation of tritium, fission events triggered by the small number of tritium atoms formed do not begin to account for the large amount of heat which is released. There must be something else. Mizuno's data again forces the conclusion which is reached.

Mizuno's book was copyrighted in 1997, but evidence has more recently become available to suggest helium-4 is also produced by the cold fusion reaction and that the amount of helium-4 formed is more commensurate with the amount of heat produced. But there was no mechanism for the formation of helium-4. On the one hand, helium-4 is rarely produced when deuterium fuses with itself, in "hot" fusion. On the other hand, Mizuno's suggestion that palladium might convert a proton into a neutron by electron capture does not suggest either the formation of an alpha emitter or the provision of something which would fission, because these actions are not the known responses to electron capture.

Considering alpha emission, analysis of the palladium rods after use shows no indication of the production of any large amount of the product of palladium alpha emission because that would form ruthenium, element 44, and no ruthenium is formed. Indeed, the heaviest strange element found is copper, element 29, so alpha emission of the palladium is ruled out by the facts.

Mizuno clearly establishes that the cold fusion process functions to transmute the palladium in the cathode to form elements containing fewer protons than are present in palladium. He suggests that this transmutation is triggered by the formation of a neutron, but electron capture is an unusual event and there is nothing to suggest it might take place here. Moreover, there is no knowledge supporting the concept that palladium will fission when it captures a neutron. E. Fermi bombarded every element with neutrons to determine its neutron capture capacity, and there is no indication that palladium responded by fission.

Turning to this writer's explanation of the mechanism of cold fusion, which was presented in *Infinite Energy* #40,[2] that mechanism again involves neutron capture, this time following the formation of a small amount of fractional hydrogen. Accordingly, that mechanism requires the presence of both

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ordinary hydrogen and deuterium in the aqueous electrolytic medium. The important point is that if neutron capture induces fission, and there is not remotely enough tritium formed to produce enough fission events to provide the heat obtained, we now have another source of neutron capture.

Let us more particularly consider Mizuno's experimental results regarding the production of strange elements in his palladium cathode to see if we can explain them. As shown in the graph at Plate 17 (from *Nuclear Transmutation*), several elements not present in the palladium rod before excess heat was produced during electrolysis were present in significant amounts afterward. These elements were platinum, chromium, iron, and copper.

Platinum is element 78, and since it contains more protons than palladium it cannot be produced by the fission of palladium which contains only 46 protons. Moreover, platinum is used as the anode, and some of it could ionize and form a cation in the aqueous electrolytic medium. The unidirectional electrical current would transport these cations to the cathode and deposit them on the cathode surface. Accordingly, the finding of platinum is to be expected and will be ignored. We shall therefore concentrate on the finding of chromium (element 24), iron (element 26), and copper (element 29), which are shown in Plate 17 to be the only strange elements present in easily detectable amounts.

In this writer's vortex theory, the nuclei of the elements follow a regular progression of structures which explain the physical, chemical and nuclear characteristics of the elements.[6] In that progression, the atomic nucleus is provided by a four-branched structure, each branch being built upon one of the four nucleons in a helium core. These branches in the heavier elements are constituted by one or more helium groups, and each branch may be terminated by either a helium group (which is chemically inert) or by a hydrogen group (which is chemically reactive).

To help one follow this regular progression of elements a circle is used in the accompanying drawing (which pictures the nuclei of the various elements discussed below) to indicate a helium group. As is well-known, the helium nucleus is a chemically inert association of four nucleons (two protons and two neutrons). A branch can be built upon each of these four nucleons. The simplest branch is one containing only one proton together with at least one neutron, this grouping of at least two nucleons being identified as a hydrogen group. Each hydrogen group is chemically reactive and is abbreviated H_2. With four hydrogen groups on a helium core we have tetrafunctional carbon (element 6). The addition of four more protons converts these hydrogen groups, one at a time, into helium groups, and this provides chemically inert neon (element 10).

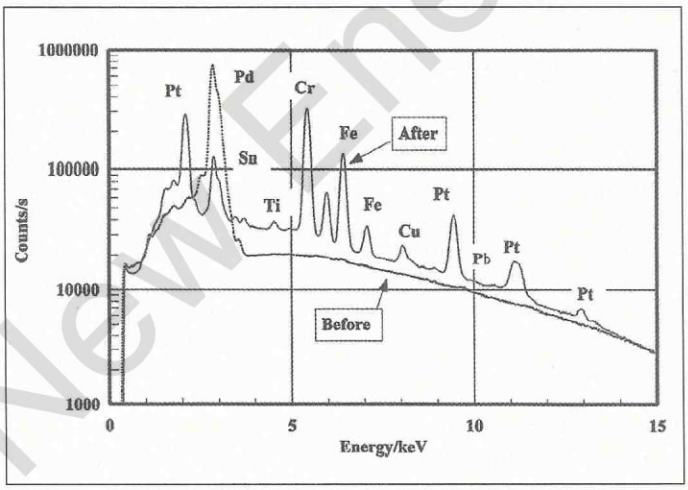

Plate 17. An example of an EDX element analysis of a palladium rod after it produced excess heat during electrolysis. Results from before and after electrolysis are shown. In the palladium rod after electrolysis, all sorts of elements are observed (from *Nuclear Transmutation*).

When we now add hydrogen groups to neon, we obtain the third period of the periodic table, and with three added hydrogen groups we have tri-functional aluminum (element 13), which carries a hydrogen group on three of its branch ends. Aluminum has a weight of 27, so the fourth branch end carries a single neutron. Adding two more hydrogen groups gives us tri-functional phosphorus (element 15), which also contains three peripheral hydrogen groups and carries a single neutron on its fourth branch end. The third period ends when all four branches terminate in a helium group, so chemically inert argon is element 18, and we now see why the second and third periods are eight elements in length.

As stated in this writer's 1980 text[6] at page 132, "Palladium, element 46, has a tri-functional phosphorus group at one end, and a tri-functional aluminum group at the other end." The functionality referred to identifies the number of terminal hydrogen groups. At page 126 palladium is indicated to be a fusion product of aluminum and arsenic containing two peripheral helium groups and six peripheral hydrogen groups. Arsenic is element 33, and at page 125 it is indicated to be a fusion product of argon and phosphorus (18 + 15 = 33). Accordingly, palladium has an argon core which is fused to an aluminum group at one end and to a phosphorus group at the other end (18 + 13 + 15 = 46).

To summarize the palladium nuclear structure, the aluminum and phosphorus nuclear groups each have four branches. The aluminum group carries a hydrogen group on three of its branches and it fuses to the argon core via a neutron on its fourth branch. The phosphorus group carries a hydrogen group on three of its branches and it fuses to the argon core via a neutron on its fourth branch. We now see why palladium carries six hydrogen groups, three at one end of the nucleus and three more at the other end.

To help one understand the drawings, each helium group is constituted by four nucleons which are positioned at a tetrahedral angle to one another, so the branches extend away from the helium core at this same tetrahedral angle and all the helium groups are connected to each other at this same angle. To simplify the drawing, these angles are ignored, and the structures are shown flat with right angles being used. Also, (n) is used to identify a neutron, so the electrical character of the neutrons is not pictured.

Now that we have the vortex structure of the palladium nucleus in mind, let us review nuclear fission starting with the nature of uranium as found on Earth. In the vortex theory the uranium nucleus contains six peripheral hydrogen groups carried by four polyhelium groups, each of which is fused to an argon core. This is something like palladium except we have four polyhelium groups fused to the argon core instead of only two. The presence of six hydrogen

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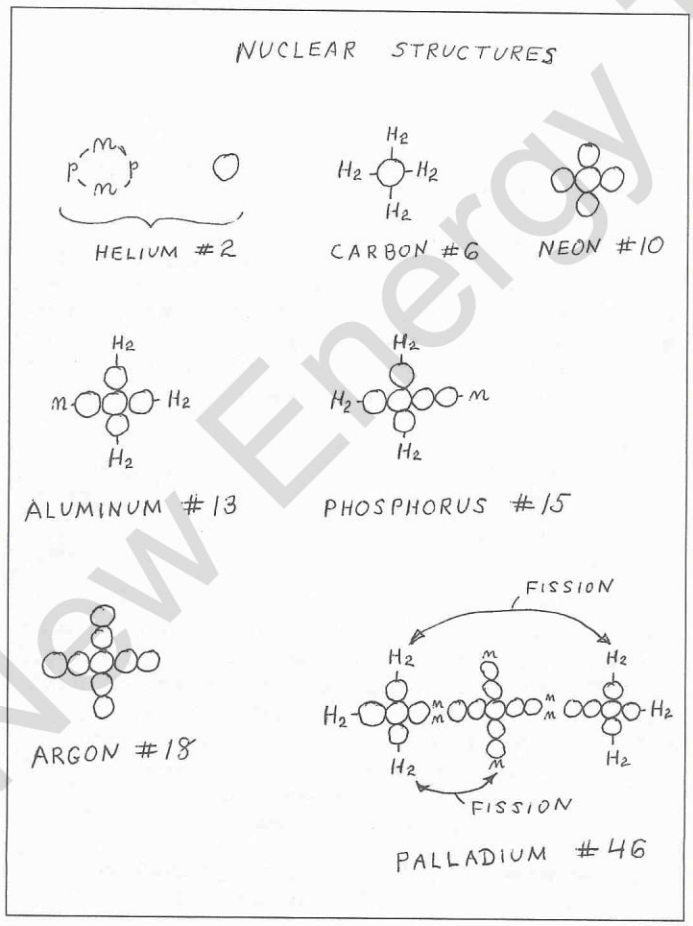
groups is explained by the fact that uranium is the sixth element in the seventh period, each added hydrogen group being carried by the structure of the inert gas (radon) which ends the sixth period. When two of these hydrogen groups on two different poly-helium groups combine, an alpha particle is usually formed and ejected to release the excess energy contained in the nucleus. This is why uranium is normally an alpha emitter, each alpha particle capturing two electrons to become a helium atom.

Turning to nuclear fission, this event occurs spontaneously for very heavy elements. But in nature spontaneous fission is rare, while alpha emission is far more common and frequent. More particularly, when uranium decays spontaneously, alpha emission occurs far more frequently than fission, so alpha emission provides an easy way for a nucleus containing excess energy and carrying more than one hydrogen group to release that energy. The products of fission also contain excess energy, and some of this is relieved by the ejection of particles shortly after the fission event. The particles ejected following the fission of uranium are usually neutrons because three neutrons provide the bond holding each poly-helium group to the argon core. This provides a very strong bond which must be disrupted to enable fission to take place. Only two neutrons form the bond to the argon core in palladium, so those bonds are more easily disrupted and the neutrons are less disturbed by the disruption.

The fission of the uranium nucleus is known to be especially peculiar, because the nucleus does not break randomly and the primary fission fragments are almost entirely constituted by only two elements, namely barium and krypton. It is fascinating to note that barium and krypton are forced to be the main products of fission by the nuclear structure of uranium in this writer's vortex theory, as detailed in the journal *Reality & Meaning*.[7] In that theory the fusion of peripheral groups, which may be hydrogen groups, fuses two poly-helium groups of the atomic nucleus to one another, and these combined groups break off where those groups were previously attached to the argon core of the uranium nucleus.



The fission of palladium following the removal of a neutron is similar to the fission of uranium. When the removal of a neutron from the palladium nucleus takes place, a hydrogen group carried on the end of one of the branches of the aluminum group fuses with a hydrogen group on the phosphorus group, and these two groups combine to join the aluminum group to the phosphorus group. These combined groups then break free from the argon core where the aluminum group and the phosphorus group were previously attached. The primary fission fragment is thus constituted by an aluminum group fused to a phosphorus group, so the fission product contains the remaining four peripheral hydrogen groups. These remaining hydrogen groups may respond to the excess energy present by combining to form either one or two helium groups which are ejected as alpha particles. These alpha particles thus carry away the excess energy. It will be noted that alpha emission is hard to detect because the helium is formed and slowed in the aqueous medium before becoming part of the gas phase above that aqueous medium.

It is also possible for one hydrogen group on the aluminum group in palladium to combine with a neutron carried by one of the branch ends on the argon core of the palladium nucleus to form a combination of those two groups. It is here noted that the hydrogen groups on the aluminum group are closer to the argon core than those carried by the phosphorus group, which is why the hydrogen groups on the aluminum group fuse more easily with the argon core. This produces a primary fission fragment constituted by an aluminum group fused to an argon group, and that fragment would contain two remaining hydrogen groups which could combine to release excess energy as a single alpha particle

It should now be clear that the neutron removal-induced fission of the palladium nucleus in the vortex theory forms a fusion product of aluminum (element 13) with phosphorus (element 15), which will eject either one or two alpha particles. If one alpha particle is released, this forms element 26, iron (13 +15 - 2 = 26). If two alpha particles are released, this forms element 24, chromium (13 +15 - 4 = 24). Fission releases considerable energy, and so does the alpha emission which follows the fission event.

If, instead, the aluminum group fused with the argon core, this would form element 29 (copper) when a single alpha group is ejected. The action is (13 + 18 - 2 = 29).

Accordingly, in the vortex theory, the fission of palladium induced by the removal of one of its neutrons will preferentially form iron, chromium and copper, exactly as found by Mizuno in the used palladium cathode. This corroborates the vortex theory nuclear structures at the same time that it corroborates nuclear fission as the source of the large amount of heat produced by cold fusion.

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The vortex analysis further suggests that argon will also be formed, but being a gas it will not show up in the cathode rod. Instead, argon should be looked for in the gas phase of the cold fusion system. Some phosphorus should also be formed, but it may not remain in the cathode as does the higher melting elements, iron, chromium and copper.

At page 95 of *Nuclear Transmutation*, Mizuno approves Conte's theory of the cold fusion mechanism, in which neutron formation takes place when a proton captures one of the orbiting electrons.[8] He suggests that "the theory accounts for all observed effects directly from first principles." Unfortunately, Mizuno does not explain how this is so, and he never describes how the formation of a neutron will force palladium to transmute almost entirely into iron, chromium and copper, as documented by his Plate 17.

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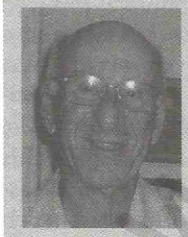
About the Author



After serving in the Army Air Corp in World War II, Mr. Gulko obtained a degree in chemical engineering and then spent four years as an Examiner in the United States Patent Office. Upon obtaining a degree in law, he passed the Virginia Bar and entered the private practice of patent law, representing diverse clients from 1952 to 1988. Mr. Gulko then retired to devote his time to fundamental studies in physics and astrophysics. Starting in 1980 he published thirteen texts, three of which are devoted to fundamental physics, the remainder being directed to the astrophysics generated by the physics. He is presently working on the use of nuclear forces in the formation of fractional hydrogen using electron beam technology.

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On the ELECTRODYNAMICS of Spinning Magnets

Jorge Guala-Valverde*

Abstract

This paper deals with a crucial issue left open by Einstein in his famous 1905 paper in *Annalen der Physik*. Recent experimental work[14] gives strong support to Weber's relational electrodynamics as well as to Ampere force law.

Homopolar Induction: Historical Scenario

"The most curious electrodynamics experiments are those where a continuous rotation takes place, called unipolar experiments."—H. Poincaré[1]

"It is known that Maxwell's electrodynamics—as usually understood at the present time—when applied to moving bodies, leads to asymmetries which do not appear to be inherent in the phenomena. . .Moreover, questions as to the seat of electrodynamic electromotive forces (unipolar machines) have no point."—A. Einstein[2]

"The system of power about the magnet must not be considered as necessarily rotating with the magnet, any more than the rays of light which emanate from the Sun are supposed to revolve with the Sun."—Michael Faraday[3]

"This is at variance with our transformation laws for linear motion, and it is an indication that the absolute rotational motion of the disk. . .can in principle be detected."—W.K.H. Panofsky[4,5]

"For nearly a century after its discovery. . .the unipolar generator was a conundrum for the theory of electromagnetism. . .The most vexatious question concerned the 'seat' of the electromotive force."—D.F. Bartlett[3]

"The whole problem baffled the greatest electrodynamicists of the nineteenth century."—A. Miller[6]

"A warping of space which is attributed to the rotation of distant masses of the universe. . .shows that an 'extra current' appears and modifies the electromagnetic tensor equations."—L.I. Schiff[6]

"Rotating circuits and magnets are 'hazardous' for Special Relativity."—D. Webster[7]

"Kennard makes no consideration about inductions on the galvanometer. This means that he does not consider the galvanometer as a part of the seat of induction."—A.K.T. Assis[8]

The essential features of the *unipolar electromagnetic phenomena* (name coined by Weber, nowadays known as *homopolar phenomena*) are shown in Figure 1, which sketches the Faraday disk, the first conceived unipolar engine. A conducting disk, free to rotate in the neighborhood of a permanent magnet, is attached to a shaft. A *closing wire* provides a conducting path between two arbitrary points on the disk. Such device exhibits a *reversible* behavior:

First Case

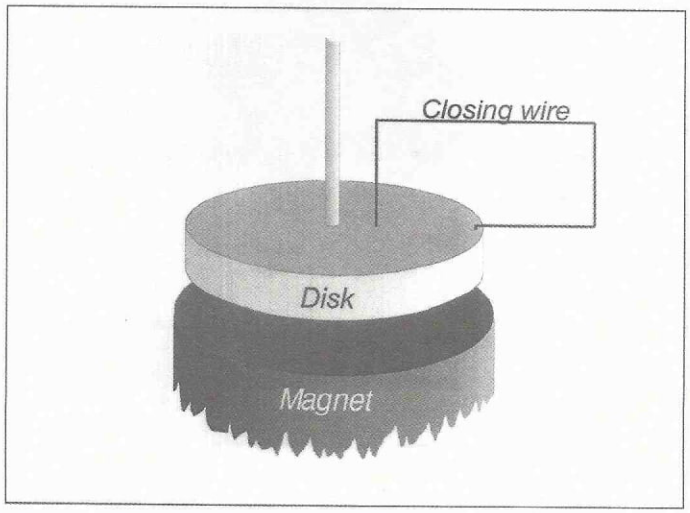
- Injecting direct current (*dc*) from an external source into the closing wire, its interaction with the magnetic field produces a *ponderomotive* Laplace force[9] $dF = I(dlxB)$ responsible for the disk rotation in a *motor* configuration.

- With the disk spun by an external source of mechanical energy, each moving charge is acted on by the Lorentz force $F = q(vxB)$, and an *electromotive* force (*emf*) appears in the bulk of the disk, in a *generator* configuration.

Second Case

A seemingly curious fact occurs when the magnet is attached to the disk. In both the above configurations the system behaves as well as if the magnet were at rest. Two rival theories, a *relativistic* and an *absolutistic* one, are customarily applied to describe *unipolar phenomena*.

Figure 1. Faraday's setup magnet, disk and closing wire.



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- Relativistic View

A generator configuration makes sense only by the motion of the magnet relative to the conductor: the disk itself in the first case, the closing wire in the second one. In a motor configuration, what matters is the *possibility* of relative motion between the magnet and the conductor: the disk in the first case, the closing wire in the second one.

- Absolutistic View

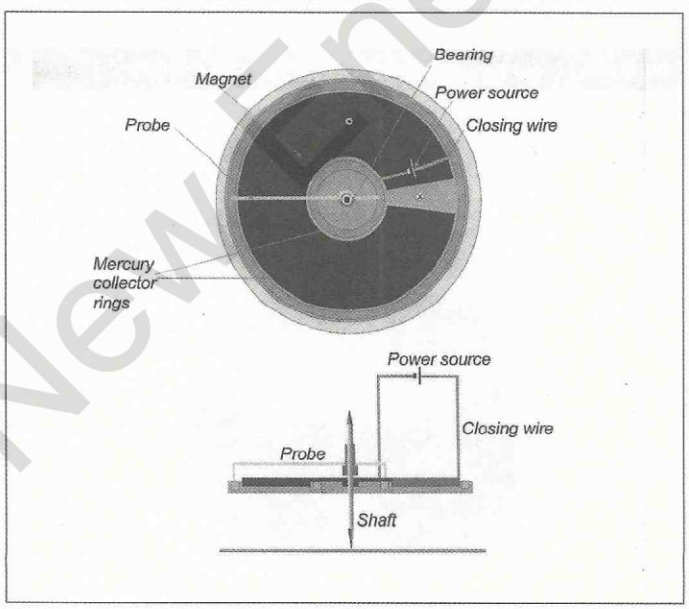
A generator configuration is enabled only because of the *absolute* motion of the conductor: the disk in both the first and second cases. Here absolute means "relative to a frame where the preponderance of the mass of the universe is at rest."[4,5] For the present purposes, the lab frame acts as an acceptable absolute-motion reference.[10,11] From an absolutistic view, the magnet's rotation with $\partial B/\partial t = 0$ in each point of the surrounding space is unable to produce an *emf* on nearby conductors.[12] The rotation observed in a motor configuration is attributed in this framework to the magnet "dragging" effect by the conductor, with the closing wire acting as a "passive" circuit element.

Experimentation performed on the original Faraday setup is not available to rule out either of the two above interpretations.[3] A remarkable experimental paper stressing the true relativistic nature of homopolar induction was recently published by A. Kelly.[13]

A Modified Faraday Disk

Figure 2 shows the *asymmetrical rotor*, a modified version of the original Faraday disk, in which a region of the magnet—the *singularity* from here on—was removed in order to achieve a *B-field* inversion.[14-17] Outgoing (ingoing) *B* vectors are represented by the • (⊗) symbol. The magnet is embedded in a wood cylinder anchored to a vertical shaft terminated in sharp points at both ends. While the lower one lays on a hard-polished surface, the upper one is centered by a conical bearing enabling its almost frictionless rotation. The inner and outer mercury collector rings allow to close a circuit through the closing wire.

Figure 2. Layout of the asymmetrical rotor applied to the experiments.



Mounted on a bearing centered with the shaft is a radial *probe* wire, whose ends are in contact with the collector rings. The probe is free to rotate about the shaft.

Figure 3 shows the *asymmetrical rotor* as applied to generation experiments. Here the magnet was embedded in a teflon disk and was dynamically balanced, accounting for the missing mass. The inner and outer copper collector rings enable the instrument's connection closing wire, terminated in carbon-electrode sliding contacts.

Experimental

During the last decade a long series of experiments were performed on unipolar induction, some of them with the aid of the asymmetrical rotor.[14-19] Since most of them have been described with much detail,[14-17] we restrict ourselves here to report only two of the whole series. Many of the these experiments were successfully repeated around the world in mid-2002.[20-30]

-Motor Configuration

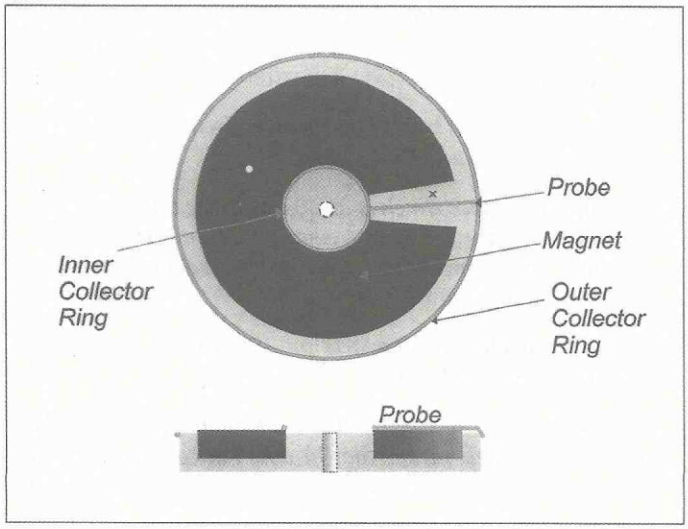
a) Rotor anchored to the lab, probe free to rotate above the magnet's downward magnetic field region: As expected by both, relativists and absolutists, a net probe *clockwise* rotation took place when ingoing *dc* was injected. Here the Laplace force $F = \int_{probe} I(dlxB)$ is responsible for the observed rotation.

b) Probe anchored to the rotor above the magnet's downward magnetic field region, both free to co-rotate. Contrary to the absolutistic expectation, a net rotor *counterclockwise* rotation took place when ingoing dc was injected. This sole experiment suffices to definitively reject the "dragging" hypothesis.

-Generator Configuration

a) Probe located on the rotor in the magnet's upward magnetic-field region. The rotor in *clockwise* rotation. A voltage $(V_i - V_o)_{uw} > 0$, between the inner and outer ring, was measured. Within the absolutistic framework, the above voltage is generated in the bulk of the probe due to the

Figure 3. Asymmetrical rotor layout as applied to Experiment 2.



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Lorentz force, which integrated along it gives an $emf = \int_{probe} (vxB).dr$. As is obvious, the velocity involved here is the probe's absolute one, since magnet's rotation (provided $\partial B/\partial t = 0$ at each point in the space) is irrelevant within an absolutistic framework.[3,4,6,12] From a relativistic viewpoint, the seat of the voltage is located on the closing wire, which is at relative motion with the magnet. Again, Lorentz force is responsible for the measured $emf' = \int_{closing\text{-}wire} (v'xB).dl$, wherein v' labels the velocity at which the considered closing-wire element dl moves with respect to the magnet. The fundamental theorem $divB = 0$, plus some elementary symmetry considerations,[19] allow us to probe that $emf' = emf$. Briefly speaking, the emf developed on the closing wire at rest in the lab with magnet and probe rotating clockwise is identical to the emf generated on the clockwise-rotating probe with magnet and closing wire stationary in the lab. The above analysis justifies, *for the first time*, conceptually wrong calculations performed by absolutists when dealing with magnet-probe sets co-rotating in the lab.

b) Probe located on the rotor in the magnet's downward magnetic-field region. The rotor in *clockwise* rotation. Again, and contrary to absolutists' expectations, a voltage $(V_i - V_o)_{dw} > 0$ was measured, as well as in the first case. This sole experiment suffices to definitively reject the absolutistic claims.

Dogma Versus Experiment

The author of this paper was, in the past, an enthusiastic advocate of the absolutistic paradigm concerning unipolar induction.[31,32] The above due to debatable philosophical reasons and, mainly, to his own ignorance of the powerful machinery underlying Weber's electrodynamics, a true relativistic doctrine also available in the realm of mechanics.[10,11,33,34] But dogma are words, and laboratory experiments are real and, sometimes, we are compelled to change old paradigms.

Concluding Remarks

The reported experiments show—beyond any reasonable doubt—that a probe wire, when moving attached to the magnet, only plays a passive role (to provide a current path) in the whole phenomenon. Both the ponderomotive and electromotive observed effects are in such a case due to the magnet motion relative to the closing wire.

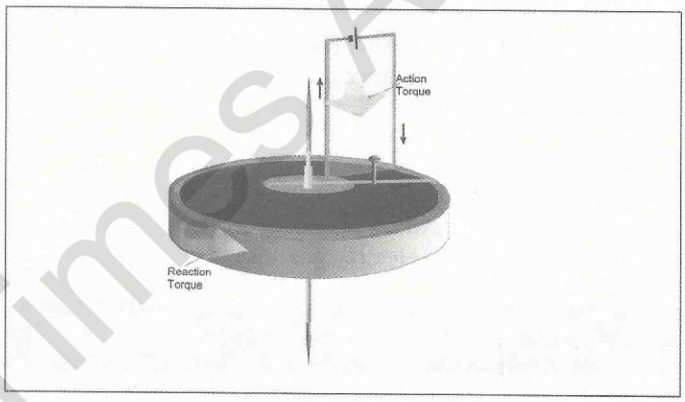
The key of the success of the reported experiments lies in the topological features of the magnet's singularity. The short-range field reversion region allows the inversion of the ponderomotive and electromotive effects on the probe, leaving the actions on the closing wire insensitive to that *B-field* reversion. This very relevant fact was exhaustively checked with the aid of specific experiments.[14,15]

Is indeed Newton's Third Law the crucial piece which allows us to rule out the absolutistic view on homopolar phenomena in a motor configuration? In fact, the whole action can be split in two elementary interactions:

Magnet-Probe Interaction:
The magnet produces a counterclockwise torque on the probe, and the probe exerts an equal but opposite torque on the magnet.

Magnet-Closing Wire Interaction:
The magnet exerts a clockwise torque on the closing wire, and the wire an equal but opposite torque on the magnet. With the probe attached to the magnet, there is no chance for relative motion between them. Consequently, due to the action-reaction cancellation effect in this case, rotation is forbidden. Conversely, with the closing wire mechanically decoupled from the magnet, relative motion of the latter is permitted. The torque exerted by the closing wire on the magnet is responsible for the observed rotation (Figure 4).

Figure 4. Rotational torques acting on the rotor and on the closing-circuit wire.



After 170 years of controversy and bewilderment, we know that—as far as induction is concerned—a wire clockwise rotation upon a stationary magnet is equivalent to a magnet counterclockwise rotation with the wire stationary in the lab (Figure 5). The above statement, contrary to the customary belief,[4,5,35] is the main outcome of our pioneering work first advanced in *Apeiron*.[14]

The new experimental evidence enhances Weber's electrodynamics, puts an end point to some claims concerning homopolar engines with an efficiency greater than unity,[36] and opens the way for further experimental and theoretical search. Particularly, Jehle's electron model deserves to be thoroughly reviewed.[3,20]

Appendix: Amperian Surface Currents

Ampere force law (Reference 10, Chapter 4) gives the force between two current elements Idl, $I'dl'$ separated by the distance r,

$$d^2 F = -(\mu_0 / 4\pi)(II'/r^2) \, [\, (2(dl.dl') - 3(r.dl)(r.dl')/r^2] \qquad (1)$$

and provides us with a suitable tool for a better understanding of the homopolar phenomena. The force is along the line joining the current elements and obeys Newton's Third Law. Repulsion (attraction) occurs as d^2F is positive (negative). As is well-known, a uniform permanent magnet can be modeled with the aid of the magnetization Ampere currents

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(Reference 4, Chapter 8). As far as the *B-field* is concerned, the magnet behaves as a cylindrical shell carrying an azymuthal current. Figure 6 shows the circular Ampere current *I'* in the plane nearest to the probe carrying the conduction current *I*. A few semi-quantitative considerations based on Equation 1 help understand torque generation. Due to its (l/r^2) dependence, Ampere force generates the main torques on the surface current elements located in the right half of the magnetic shell. Let us consider the action between a fixed current element *Idl* located near the end of the probe (high torque region) and an arbitrarily located *I'dl'* surface current element. When resting in the upper (lower) right quadrant, *dl'* is attracted (repelled) by *dl* as shown in Figure 6. The above forces have both radial and azymuthal components acting on the bulk of the magnet, being the last ones responsible for its clockwise rotation. The closing wire exerts, of course, a counterclockwise torque on the magnet. Attaching the probe to the magnet, the only action able to produce motion is now between the closing circuit and the magnet.

We end this essay by quoting James Clerk Maxwell referring to Ampere force: "The whole theory. . .is summed up in a formula. . .which must always remain the cardinal formula of electrodynamics."[37]

Acknowledgments

Appreciation goes to Andre Koch Torres de Assis, who fired my interest in Weber's electrodynamics; R. Achilles, R. Blas, and C. Gagliardo, who were able to repeat the whole series of experiments at Rio IV University; P. Mazzoni for his mastery in experimental physics; and Tom Phipps, Jr., who shares my views on a possible physics quite independent of observers beyond the true experimenter.

Figure 5. Homopolar induction only depends on the motion of magnet relative to disk.

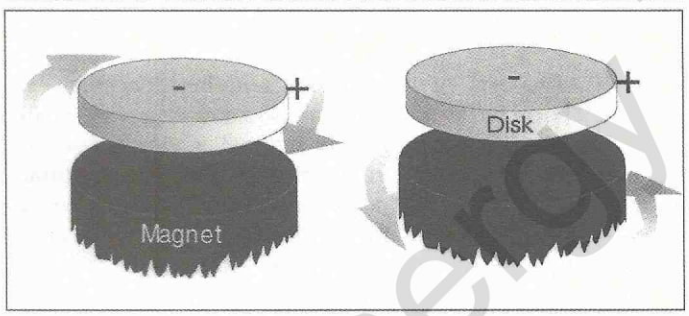
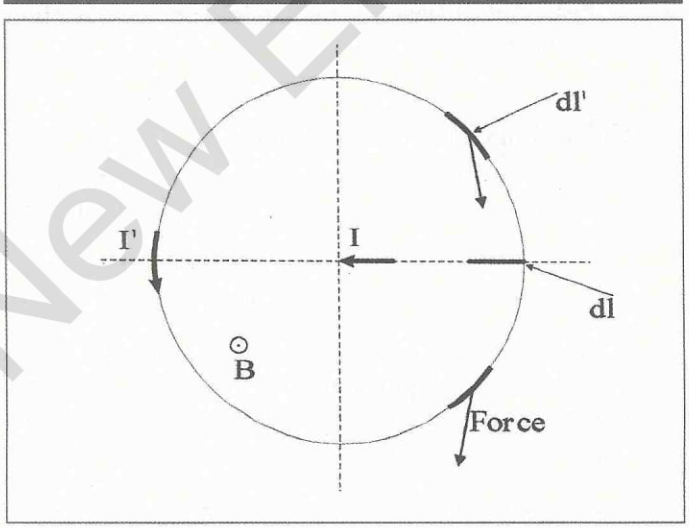


Figure 6. Actions between current elements according to Ampere.



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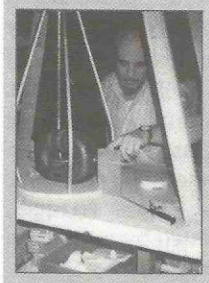
About the Author



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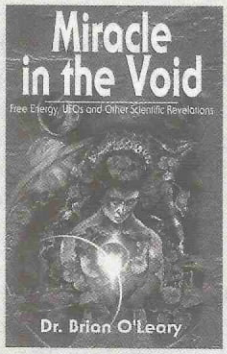

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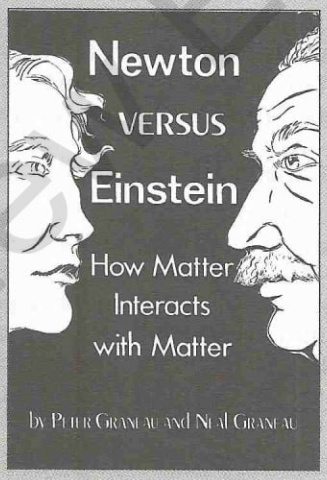

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Phase Transitions, Sorting Processes, and the Second Law of Thermodynamics

Remi O. Cornwall*

Abstract

This paper discusses means of obtaining macroscopic work from one reservoir at constant temperature and heat is shown *not* to be a dead-end of energy transmutation. Dynamic equilibrium is represented from the viewpoint of continual microscopic work. Pointers are derived to show how at least in principle it is possible to obtain *microscopic work*. Phase change is shown as a means of magnifying microscopic work to macroscopic work. This is called the *Phase Transition Sorting Theory* and depends on constant temperature processes, such as phase changes. Phase change is seen as making the internal energy differential non-exact by addition of potential energy terms; consequently net work accrues when we take the working substance through a complete cycle.

We discuss the Maxwell Demon Problem and how phase transitions present a new class of demon that is realizable. The link between the thermodynamics, multi-body dynamics, and the ideas presented is made explicit, at least qualitatively at this stage, with discussion of ergodicity and equilibrium and how sorting would work on the molecular level by, once again, changing the potential energy function. We conclude that the temporary remnance of second order phase transition is the most practical implementation for large scale energy production, but the engineering details are proper discussion for another paper.

Introduction

This paper aims to show that the Second Law of thermodynamics is not fundamental and at best merely a statement of the Zeroth Law. The pessimism surrounding the law is shown wrong, and that heat is not a dead-end of energy transformation, by a Maxwell Demon process of *phase transition sorting*—the *Sorting Theory*. Thermal systems have complex multi-body dynamics whose paths in phase space are chaotic and hence ergodic. We draw an analogy with simple one- or two-body systems where modification of the restoring force can lead to different behavior. Our argument in thermal systems, changing the "restoring function," leads to less chaotic behavior or partial ordering. We arrive at the same result as the Phase Transition Sorting Theory—a change in the potential energy function between particles occurs.

Macroscopic engines operate from macroscopic potentials or reservoirs to do useful physical work; an example is hydroelectric power. This type of scheme of cycling in a fundamental potential approximately involve only one degree of freedom of the working substance, and so all the potential energy can be liberated as kinetic energy of the working substance.

Another type of macroscopic engine is the heat engine operating through macroscopic "potentials" of temperature. Through the work of Carnot, Clausius, Maxwell and Boltzmann,[1,12] we now understand the kinetic basis of heat. Regions of higher potential or temperature are understood to be regions of more vigorous motion. In this many degree of freedom system, energy will partition amongst all the various molecular constituents, so energy will flow from the upper reservoir to the lower by a mechanism that is statistical in basis.

Through imperfection in design of heat engines and the Equipartition of Energy, the Second Law is believed to express a fundamental aspect of energy becoming "unavailable"—even engines operating in true fundamental potentials will suffer friction and so degrade to heat. This law is meant to be synonymous with the Zeroth Law and the Equipartition Principle. We aim to show that the correct viewpoint is that Equipartition is the *mechanism* for the fall in potential of a thermal gradient and because heat is not the dead-end of energy transmutation that the Second Law is redundant and at best just an expression of the Zeroth Law. The Carnot Efficiency rule is thus seen as a *particular case* of macroscopic engine operating between two thermal reservoirs.

To prove this redundancy, we show the Second Law contradicting itself by a simple First Order Phase Transition thought experiment. We understand first order processes as *constant* temperature processes and develop this key point by reviewing dynamic equilibrium as a continual interchange of microscopic work and rising potential energy processes. Theorems state the requirement for constant temperature processes and phase changes to obtain macroscopic work. We then consider two other second order processes. The emerging theme of constant temperature processes, phase changes, microscopic and macroscopic work is elucidated by discussion on *Sorting* and the Maxwell Demon (MD) Problem.

By considering the change in thermodynamic function *per* particle, we prove the Sorting Theory as a change in *potential energy* and hence *phase* of the working substance. This analysis can be considered *mesoscopic* in that we are explaining microscopic motion in terms of macroscopic thermodynamic potentials.

Finally, we analyze semi-descriptively (more work needs to be done here) thermal systems as multi-body dynamics. The criteria of at least three degrees of freedom and non-linear coupling terms ("restoring forces") between the equations of motion leads to chaotic dynamics—that is, the system is ergodic. By changing the coupling terms, the *potential energy* terms, the motion can be made more regular. This is in agreement with the Phase Transition Sorting Theory.

Dynamic Equilibrium and Microscopic Work

Consider a gas in a gravity field in a closed isolated system at equilibrium. A strange way of looking at this equilibrium case is to consider that gas molecules with a vertically upwards component to their motion *are* doing work against gravity and that ones with a component vertically downwards *are* doing work on the gas system. The two work terms obviously cancel because the gas does not heat up—no net energy has been supplied to the system.

If we slightly decrease our magnification and not view individual molecules but a small ensemble, we will see

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Figure 1.

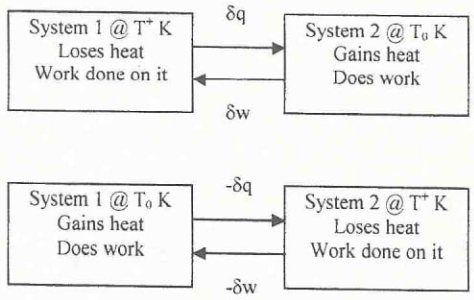
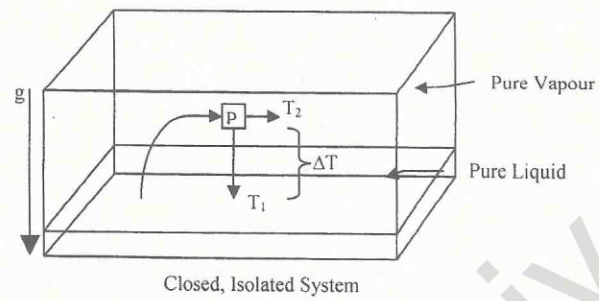


Figure 2.



fluctuation in thermodynamic parameters over regions of the system. Let us consider two such adjacent regions in contact (Figure 1). By statistical fluctuation, system 1 momentarily rises in temperature to pass this on to system 2, which expands, then cools and does work on system 1. We show on the right the converse. Using infinitesimal quantities we find that the thermodynamic identity is not violated for these processes:

$$dU = \delta Q - \delta W$$

There is no change in internal energy or change in entropy. It seems that at least microscopically this leads to:

Constant Temperature Theorem:
At constant temperature, heat and microscopic work are interchangeable.

We shall prove:

Macroscopic Work Theorem:
It is possible to do macroscopic work in closed, isolated system with only one reservoir.

Macroscopic Work 1: First Order Phase Transition Violation of Second Law

Reconsider our isolated equilibrium system with two phases present of the water (Figure 2). We introduce our "phase changing catalyst" P which could be a long tube with a hygroscopic solution and a semi-permeable membrane at the bottom—this is just a thought experiment. Vapor will condense at the top, leading to a temperature rise and potential energy from change in density of water from vapor to liquid. A thermodynamic cycle in the sense of a flow of matter around a loop manifests itself as:

- Utilization of the *spontaneous* phase change of part of the low-energy phase of working substance to high-energy phase by flow of matter into process P. This occurs because the vapor pressure of the liquid and vapor must equalize, which is a consequence of the equalization of the Gibbs' functions for the vapor and liquid phases.
- Promotion of a spontaneous phase change of part of the working substance in vapor phase passing through process P to liquid phase.
- Return of liquid condensed to reservoir.
- Collection of exit vapor from P elevated in temperature.
- Cooling, condensing, and then return of working substance to the reservoir.

Below we show a simple Second Law calculation; a more involved calculation taking into account chemical potential is merely tedious. Appendix 1 contains a more detailed explanation with a phase diagram of $CaCl_2/H_2O$ for physical reference.

Step 1) Vaporization of liquid: $\Delta S_V = ML / T_1$

Step 2) The entropy change of process: $\Delta S_P = -(1-k)\, ML / T_1 + k\, MC_V \ln (T_2 / T_1)$

Step 3) Cooling of the exit vapor: $\Delta S_C = k\, MC_V \ln (T_1 / T_2) = -k\, MC_V \ln (T_2 / T_1)$

Step 4) Condensation of exit vapor: $\Delta S_L = -kML / T_1$

$$\Delta S_{Total} = \Delta S_V + \Delta S_P + \Delta S_C + \Delta S_L = 0$$

By conventional thinking, total entropy change is zero or greater than zero and so the process occurs. First order phase transitions are characterized by:

- A sudden change of properties at *constant temperature*. These property changes are sudden changes in density, compressibility, and viscosity, like the change transition from liquid to gas.
- *Latent heat* associated with the potential energy overcome in matter moving from the low to higher energy phase.

According to the Constant Temperature Theorem, heat energy does the work necessary to overcome the potential energy difference between the phases because the process occurs at constant temperature. Also the phase being macroscopic allows a macroscopic flow of matter even though the phase boundary is a microscopic process.

Macroscopic Work 2: Second Order Phase Transition Violation of Second Law by Magneto-calorific Effect

We now introduce a cycle using second order phase transitions. Appendix 2 contains background to the magneto-calorific effect. Below is shown the magnetization curve for a ferromagnetic material near its Curie point with (H>0) and without (H=0) an applied field. Essentially we surround the working substance, which is the ferromagnetic material with an electromagnet capable of supplying rectangular pulses. Our starting point in the cycle is point 1 in Figure 3, just beyond the Curie temperature of the sample.

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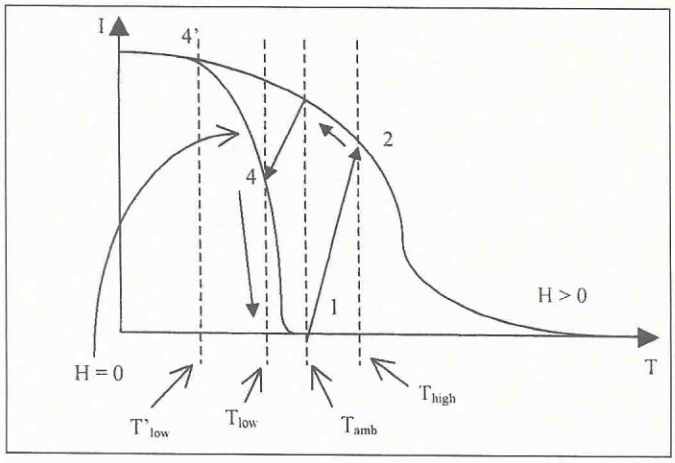

Figure 3. 1-2: Field suddenly applied to sample and warms above ambient, magneto-calorific effect. 2-3: Sample cools. 3-4: Field switched off suddenly, sample cools below ambient. 4-1: Sample below Curie point, has independent magnetic moment and can generate electricity. 4': Allows a variation where the induction is higher at step 4 than 3.

The changes in temperature of the sample when the field is applied are essentially instantaneous as thermal vibrations are distributed amongst the internal degrees of freedom of the system not "frozen out" by the magnetic field. However, at the last step 4-1, the electromagnet current is off and the flux is *independent* (Appendix 3) and collapsing at the rate at which heat energy can flow into the sample and bring it back to ambient. The energy balance for this cycle has two major components, the others being negligible or able to be made so, the field energy and the energy from the change in dipole moment of the working substance (Appendix 4):

$$P_{field} = -\xi\varepsilon_0 c^2 B_f^2 FV$$

$$P_{dipole} = \frac{n^2 k}{R} V^2 B \frac{dB}{dt} F$$

Please consult Appendix 4 for the variables, but essentially the terms that matter are the V (volume which is squared) and the BdB/dt term. F gives the frequency of the cycle's execution. Note also that if the field energy is recouped with high efficiency, each cycle ($0<\xi<1$, $\xi\rightarrow 0$ is good) then power generation dominates. For a detailed look at the thermodynamics of this cycle, please consult Appendix 5.

Macroscopic Work 3: Another Second Order Transition by Temporary Remnance

We can design still another cycle based on ferromagnetic materials well below their Curie temperatures, but subject to Brownian relaxation by being finely dispersed in a carrier fluid (hence a "ferrofluid"). This cycle is more amenable to engineering and is the approach used by the author[2]; also this cycle doesn't need to operate around one temperature or require very high fields.

Figure 4 above shows a magnetization I vs. temperature T curve for the temporary remnance cycle. Unlike the magneto-calorific cycle when the field is switched, there is no temperature change because the working substance is composed of material well into the ferromagnetic regime, far from the Curie point. Surprisingly too there is virtually no (or at least immeasurable) hysteresis heating from the magnetic entities turning

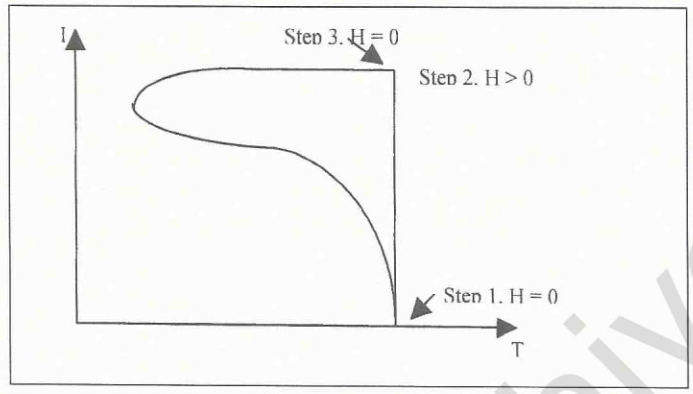

Figure 4. 1-2: Field applied to, no magneto-calorific effect, sample magnetized. 2-3: Field off suddenly leaving temporary magnetic moment. 3-1: Temporary moment subject to buffeting from surrounding liquid but does electrical work.

in the fluid if it is below some critical frequency related to the relaxation rate of field collapse.

The field is switched off suddenly at step 2 to get the independent flux condition—that is the exciter field switch off speed must be negligible compared to the working sample's relaxation time. The curve executes the path from 3 to 1 [Kinetic Theory would have to be suspended otherwise. The relaxation frequency is given by $f=f_0e^{-E/kT}$ where f_0 is of the order of 100GHz (Néel Frequency[5]). If we reduce the rate by say hydrodynamic radius increase we modify E (the energy barrier). Once we start taking power from the device, we modify E again but by a relatively miniscule amount so the relaxation rate is hardly affected.], which we can only describe qualitatively: Near the start of the curve when the dipole moment is large the working substance does the greatest electrical work into the load and so the temperature fall is the greatest. As we shall see later, the process of loss of magnetization is an order-disorder transition (second order) by thermal disruption from the surrounds of the magnetic aspect of our system. As the magnetic moment falls the working substance does less work and so the temperature rises again to ambient. The power terms from the previous section of field and dipole apply.

Phase Transitions, Macroscopic Work, and Maxwell's Demon

We developed a theory that showed that microscopic work is possible at constant temperature. We then discussed three cycles that operate in a reservoir at constant temperature and are able to generate work by effectively forming "virtual" reservoirs by which heat can flow; nevertheless, overall work is done from one reservoir. The process of forming a phase boundary or phase change involves microscopic work processes but *phases are macroscopic regions* so this microscopic work becomes available. This leads to:

Phase Transition Sorting Theorem:
Macroscopic work is obtainable from microscopic work processes at constant temperature by the working substance undergoing a phase transition.

This can be understood from the thermodynamic identity:

$$dU = TdS - PdV + \mu(P,T,\phi)$$

The symbols have their usual meaning and ϕ is a potential function of position. Since dU is an exact integral, *any* means

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of cycling the working substance by any of the variables of the system will not produce excess energy *from the system*—that energy will come from the *external* source driving the system and leave it as work done by the system. The thermodynamic coordinates return to their values at the start of the cycle, leaving the system with the same internal energy.

If we make the differential inexact by changing μ, the integral can be made non-zero and more importantly positive so that the *internal energy of the system changes* and we accrue the microscopic work (see Appendix 5). First let us "unpack" the chemical potential's meaning: it is the thermodynamic potential per particle:

$$du = Tds - pdV + \phi$$

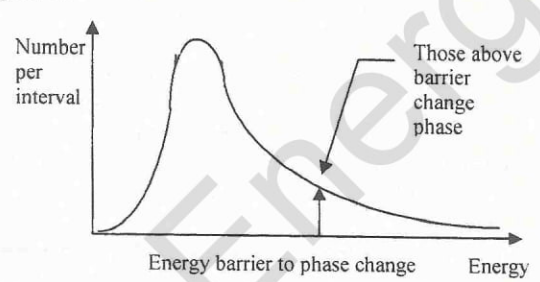
Where s and p are the entropy and pressure per particle. The chemical potential has two parts, the "internal" and the "external." The internal potential is defined as the chemical potential if an external potential is not present. If we are to extract *internal energy from the system*, the expression for dU must be made inexact:

$$\delta u = Tds - pdV + \phi + \phi'$$

A change of μ can only correspond to a phase change, as this will introduce potential energy terms, ϕ' such as latent heat or new magnetization energy terms, for instance. This energy can me made large enough to accrue net energy on each cycle to cycle the working substance.

Consider now first order phase transitions, with which we can view the phase change process at the interface in an unusual manner as work being done at constant temperature against the potential barrier. In fact, when one considers the barrier and the Maxwell-Boltzmann distribution, there appears to be a *sorting process* whereby the molecules at the top end of the distribution have the energy to exceed the barrier (Figure 5).

Figure 5.

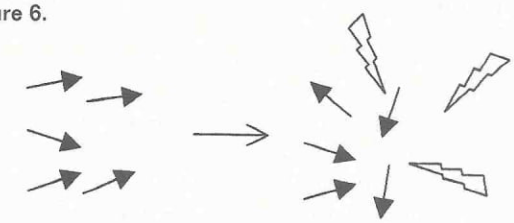


The second order phase change does an *inverse sorting* procedure where we sort initially to let the reservoir disorder again. The energy flow from the reservoir amounts to a decrease in its entropy (Figure 6).

The notion of sorting reminds us of the original problem of the Maxwell Demon problem. Appendix 6 contains a quick survey of the field with references.

We now introduce another type of MD that is possible. It has to affect its sorting at the molecular level like the Ratchet and Pawl or Pressure Demon, but the sorting threshold is *an energy barrier* so it will not suffer Brownian Motion and be rendered ineffective. The measurement is intrinsically *self-sorting and requires no energy input for the discrimination process*, thereby circumventing the Kirchoff, Brillouin, and Szilard measurement argument. This third type of realizable MD is physical phase change: *By the ideas presented earlier we have seen that microscopic work is possible at constant temperature. To achieve macroscopic work we must form macroscopic regions of differing thermodynamic potential. An expression of microscopic properties at the macroscopic level is the phase of a substance.*

Figure 6.



1) Magnetic field orders part of the system. A small amount of field

Energy input $\propto e_o c^2 B^2 V$

2) Buffeting from rest of system.

Large coupling constant when field collapses. energy out $\propto BdB/dt$

Microscopic work is possible across the energy barrier or a first order transition or the disordering process of a second order transition.

Chaotic Multi-body Dynamics and the Maxwell Demon

The proceeding discussion leads to the proof of the Phase Change Sorting Theory by application of macroscopic thermodynamic potentials to individual particles, this line of reasoning is *mesoscopic* and we would like to express the argument *microscopically* particle by particle. We will arrive at the same result that the potential energy function between particles changes and allows the sorting to occur; however, we shall see here that the dynamics in phase space are made less chaotic.

First we shall proceed with conservative one- and two-body mechanics, but we shall see in a sense that all systems are conservative. Very good accounts can be found in many reference materials.[3,13-16] When dealing with closed orbits, the particles trace a closed path in phase space that is independent of initial conditions and predictable to any degree of accuracy.

Figure 7.

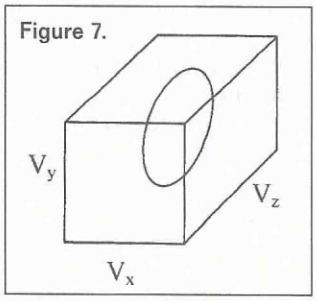


Figure 7 depicts the path of the particle in velocity space. The path is regular and non-decaying since the system is conservative. There is a continual interplay between kinetic and potential energy by the restoring central force and the motion is harmonic.

However, the situation changes with the three-body problem and the path in space becomes chaotic. The equations of motion of the system have three degrees of freedom and non-linear coupling between them—hence why chaotic behavior becomes apparent in three-body motion. Full discussion of this is beyond the scope of this paper, but essentially what happens is that a "strange attractor" is formed, the phase variables having at least one positive Lyapunov[13] exponent. One of the phase coordinates increases exponen-

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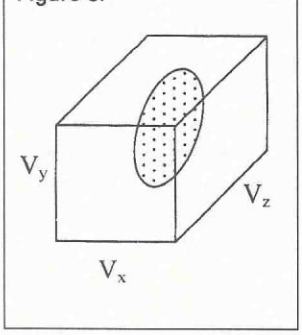
tially but is constrained by the other variables of the system to stay within a finite phase volume. References 13-16 show how this can be modelled as a mapping operation such as the Smale Horseshoe, the result is a continual refolding of phase trajectories resulting in infinitesimally fine structure (actually fractal). This is the source of the exponential loss in accuracy when specifying the system from initial coordinates to some point in the future. The motion is chaotic, unpredictable but constrained and hence "strange."

We know from celestial mechanics that not all three-body problems are chaotic; pseudo-regular to regular motion exists (reduced three-body problems think Sun-Earth-Moon). This difference occurs by the strength of the non-linear coupling terms in the governing equations of motion. *These terms are the potential energy functions of the system.*

Figure 8.

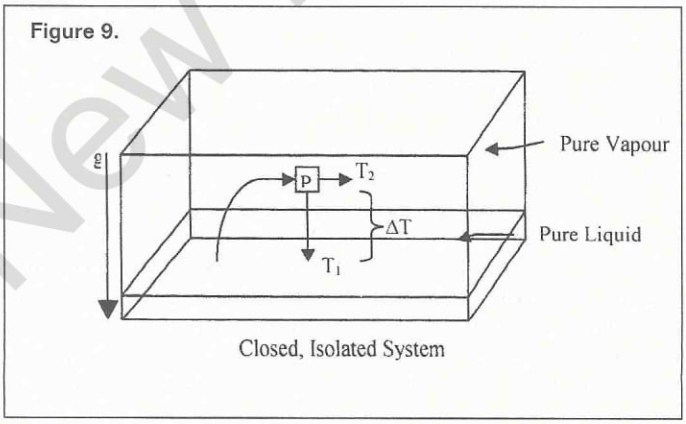


We can represent n-body dynamics by plotting each particle's velocity in velocity space. Instead of a path, we obtain a volume (Figure 8). The motion is called ergodic[1,4] because every part in the phase volume is reachable. However, the kinetics of the process and the sameness (or degeneracy) of some of the states of the system make some parts of the volume more occupied than others (a greater density of points). Thus an equilibrium distribution is obtained and the phase volume evolves to a constant shape or distribution, such as Maxwell-Boltzmann or Fermi-Dirac/Bose-Einstein if the particle concentration is high and quantum effects become important. If we start with an ordered system in high-energy states, the phase volume will evolve to its statistically most likely—this is the Zeroth Law or potential decrease that we observe with fundamental potentials except here the mechanism is statistical.

As mentioned in reduced three-body problems, quasi-periodic motion can exist by changing the potential function. By the same token we can take an n-body system away from equilibrium by altering the potential functions (restoring functions) between the particles and make it more *ordered. Energy cycles ad-infinitum* between kinetic and potential energy like one-or two-body motion/oscillation and the system is conservative, if we include all the particles but executing quasi-periodic motion.

Consider the system in Figure 9. We change the potential functions at some point in the system by a *phase change* and take part of the system away from equilibrium. This part at T_2 we can simply let dissipate and mix with the rest of the system chaotically or interact more orderly with a heat engine. Indeed the reservoir, the power unit system on which the work is done, all become part of this pseudo-oscillator. Regularity in the system is represented by ensemble averages with spatial or temporal variation; we can't really trace the path of an individual particle but can say that the system is more ordered.

Figure 9.



Conclusion and Status of Our Practical Researches

We have shown, to people who are willing to accept a rational argument, that simple phase changing processes violate the Second Law. Our starting point was to prove the existence of microscopic work in the dynamic equilibrium state. Three phase transitions were analyzed in this large equilibrium reservoir and found to be able to generate macroscopic potentials for real engines. It became apparent that the microscopic work was instrumental in the forming of phase boundaries and that since a phase is a macroscopic region, if it can be made unstable it will liberate this microscopic work. Discussion of the Maxwell Demon problem showed that first order phase transitions sort by the energy barrier between the phases. Second order transitions (so-called order-disorder transitions) can be made to sort by an "inverse sorting" procedure where the region is first ordered, then allowed to disrupt by Brownian motion buffeting. The energy balance is asymmetrical, favoring energy liberation.

Mesoscopic arguments (macroscopic thermodynamic potentials applied to individual particles) and microscopic arguments (n-body dynamics) came to the same conclusion that potential functions change between particles. We affect a distribution change away from equilibrium and need no longer talk about the system being non-conservative. We can view the system as being in pseudo-oscillation: kinetic and potential energy cycle ad-infinitum just as for one- or two-body conservative systems.

Practically, the author is making a power unit working with the temporary remnance cycle using ferrofluids. Another paper will be written concerning the theoretical engineering and practice of this once the investor in the author's work is satisfied that new techniques have been patent protected. Currently, 1 kW units are being researched with 10 kW and 100 kW units in design.

Appendix 1: First Order Violation of Second Law by $CaCl_2/H_2O$) System

This system is an extension of the first system discussed to expand a point that some people find difficult. Macroscopic flow seems impossible but we must consult the phase diagram to see what really happens. The system is in no way practical, but we wish to show that a fundamental law cannot be expressed in terms of practical difficulties. This has been the line of the detractors.

The "phase changing catalyst" is made from a long vessel filled with $CaCl_2$ and a semi-permeable membrane at the bottom of the vessel. We start at 20°C say (start point). Around it is an atmosphere of water vapor at 20°C too. Water vapor will condense onto the $CaCl_2$ (intersection point) at say 30°C, forming a solution.

Detractors believe that the solution will just sit there and

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(Phase diagram from Kirk-Othmer *Encyclopedia of Chemical Engineering*)

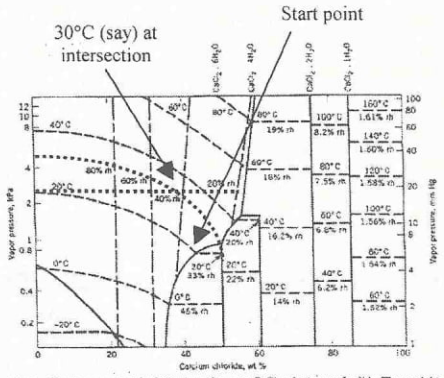

Fig. 1. Vapor pressure and relative humidity over $CaCl_2$ solutions and solids. The straight horizontal lines in the right-hand portion represent two solid phases and a gas phase for vertical line intersections. In addition, a solid phase, saturated solution, and a vapor phase occur in the regions between the vertical lines. The lower left-hand corner shows the ice solution line. The region in between, with skewed isothermal lines, represents unsaturated solutions; the vapor pressure varies as a function of temperature.

not flow through the semi-permeable membrane, eventually cooling and then sitting in dynamic equilibrium with the surrounds. This is impossible if the column height is high enough to overcome osmotic pressure and surface tension. Let us pursue osmotic pressure, as this is by far the largest.

Let the chemical potentials of the vapor and liquid in hygroscopic solution be written as a function of altitude:

$$\mu_g = C_g(T) + RT \ln P + Mgh$$
$$\mu_h = C_h(T) + Mgh \qquad \text{Eq. A1.1}$$

where $C_g(T)$ and $C_h(T)$ are functions of temperature, only h is the altitude above a reference height at liquid level, P is pressure at altitude h, M is the molar mass of the working substance, and g is the acceleration due to gravity.

Now $(\mu_g - \mu_h) > 0$ *for condensation to occur*. Hence,

$$C_g(T) - C_h(T) + RT \ln P > 0 \qquad \text{Ineq. A1.2}$$

It is a simple matter to show by equating the chemical potential of the vapor at different heights that the pressure follows an exponential law with altitude:

$$P = P_{bot}\, e^{-Mgh/RT} \qquad \text{Eq. A1.3}$$

where P_{bot} is the pressure of the atmosphere at the liquid surface from which h is measured.

Substituting A1.3 into A1.2 yields

$$P_{bot} > e^{(Mgh - \Delta\mu)/RT} \qquad \text{Ineq. A1.4}$$

where $\Delta\mu = C_g(T) - C_h(T)$

Now for the *flow against osmotic pressure* through the membrane

$$(\mu_g - \mu_h) \le h\rho g \qquad \text{Ineq. A1.5}$$

where h is the height of the column, ρ is the density of the hygroscopic liquid, and g is the acceleration due to gravity.

Substituting A1.1 into A1.5 yields:

$$P_{bot} \le e^{(h\rho g - \Delta\mu)/RT} \qquad \text{Ineq. A1.6}$$

Bringing together inequalities A1.4 and A1.6:

$$e^{(h\rho g - \Delta\mu)/RT} \ge P_{bot} > e^{(Mgh - \Delta\mu)/RT}$$
$$\Rightarrow \quad h\rho g - \Delta\mu > Mgh - \Delta\mu$$
$$\Rightarrow \quad \rho > M$$

Now ρ is the density of the hygroscopic solution, which can be written as: cM/V. If the liquid was pure like the vapor, we would just write M/V, however the liquid is dense due to the $CaCl_2$. Thus substituting in the above inequality we obtain:

$$V < c$$

The molar volume of water is 18 ml, or $1.8 \times 10^{-5} m^3$. The $CaCl_2$ forms a dense solution (c > 1) and so height will always overcome osmotic pressure, also the fall in barometric pressure of the vapor won't affect condensation if the vapor pressure of the hygroscopic solution is sufficiently low. Let us take the example on the phase diagram: we end up at about 37% $CaCl_2$ by weight, which works out at about 5.3 moles/l. The osmotic pressure (1 atm per 1M in 24.681 at r.t.p.) would be 130 atms. The $CaCl_2$ solution will have relative density of about 1.6. A column of solution would overcome its osmotic pressure at about 840 m. The vapor pressure will be 94% of its zero altitude value. Consulting the phase diagram, the process still occurs.

Other objections are flow losses. Flow losses increase monotonically with some non-linear power of velocity. If we decrease the velocity but increase the cross-sectional area, we surmount this problem.

Thus we have in a system supposedly at dynamic equilibrium with spatial variation in temperature—a system in steady state equilibrium.

Although obviously not practical (the temporary remnance cycle *is*) these engineering issues are not *fundamental* to the problem and do not constitute a defense of the Second Law.

Appendix 2: Background to Magneto-calorific Effect, Ferromagnetism, and Paramagnetism

Ferromagnetic materials are characterized by several properties: relative permeability greater than unity, spontaneous magnetization, hysteresis when induction is plotted against incident field—hence domains and the so-called Curie Point Temperature, above which the material becomes merely paramagnetic. It is this phase transition to the paramagnetic state that we exploit to turn heat into electricity. First, however, we shall discuss how the spontaneous magnetization varies with temperature. Within a domain of a ferromagnetic material, the saturation magnetization is modelled well by the Weiss[5] Equation A2.1. Equation A2.2 is the Brillouin function. Equation A2.3 is the ratio of average spin to total spin that Equation A2.1 predicts. H is the applied field and α is the so-called "molecular field" related to the exchange interaction between the atoms of the sample.

$$\mu = B_S(H + \alpha\mu) \qquad \text{Eqn. A2.1}$$

$$B_S = \frac{2S+1}{S}\coth\left(\frac{2S+1}{S}x\right) - \frac{1}{2S}\coth\left(\frac{x}{2S}\right) \qquad \text{Eqn. A2.2}$$

$$\mu = \frac{\langle S_Z \rangle}{S} \qquad \text{Eqn. A2.3}$$

$$h = \frac{g\mu_B SH}{k_B T} \qquad \text{Eqn. A2.4}$$

$$\alpha(T) = \frac{2S^2}{k_B T}pJ \qquad \text{Eqn. A2.5}$$

μ_B is the 'Bohr magnetron'

$$\mu_B = \frac{|e|\hbar}{2m_e c} \qquad \text{Eqn. A2.6}$$

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Figure 10.

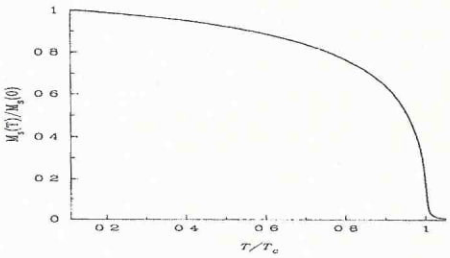
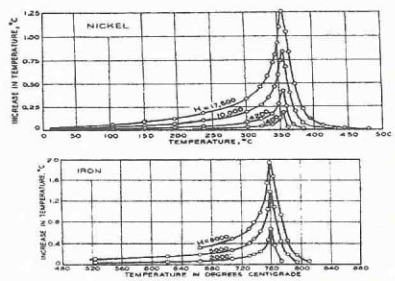


Figure 11.



where g is the "Landé" or "spectroscopic splitting" factor, e is the quantum of electrical charge, h is Planck's constant divided by 2π, m_e is the mass of the electron, c is the speed of light, k_B is Boltzmann's constant, p is the number of nearest neighbors in the lattice, J the exchange energy integral.

Figure 10 shows a plot of the first equation ($H \rightarrow 0$) with μ normalized against the maximum value it obtains at zero Kelvin and Kelvin temperature, T, divided by the Curie temperature T_C. It shows how the spontaneous magnetization falls rapidly near the Curie point.

The Magneto-Calorific Effect

If a ferromagnetic sample is exposed to a magnetic field adiabatically its temperature will rise; when the field is removed, it will fall back to the original temperature. We can model this as follows:

$$dU = TdS + HdI \qquad \text{Eq. A2.7}$$

where H is the magnetic field and I is the magnetization. If we take S and H as independent variables, double differentiation gives:

$$\frac{\partial^2 U}{\partial H \partial S} = \left(\frac{\partial T}{\partial H}\right)_S = -\left(\frac{\partial I}{\partial S}\right)_H = -\left(\frac{\partial T}{\partial S}\right)_H \left(\frac{\partial I}{\partial T}\right)_H \qquad \text{Eq. A2.8}$$

By definition, the heat capacity at constant field strength is:

$$c_H = \left(\frac{\delta Q}{\delta T}\right)_H = T\left(\frac{\partial S}{\partial T}\right)_H \qquad \text{Eq. A2.9}$$

Combining this with the previous equation, we obtain:

$$c_H = -T\left(\frac{\partial H}{\partial T}\right)_S \left(\frac{\partial I}{\partial T}\right)_H$$

or

$$(\Delta T)_S = -\frac{T}{c_H}\left(\frac{\partial I}{\partial T}\right)_H \Delta H \qquad \text{Eq. A2.10}$$

The change of magnetization is at its greatest near the Curie point, as shown in Figure 11 (graphics courtesy of Bozorth[6]). Plotted is the increase in temperature vs. temperature of the sample (°C both) for nickel and iron. The magnetic field shown (H) is measured in Oersteds.

These temperature changes are small but as we return to the discussion of the thermodynamic cycle, it will become apparent that we can go around the cycle many thousands of times per second and convert much heat to electrical energy.

Appendix 3: Proof that a Dependent Flux Always Leads to Net Zero Electrical Work in a Cycle and the Necessary Condition of Independent Flux for Power Generation

Consider an inductor as some circuit element. The net energy for a cycle is given by:

$$\int_T vi \cdot dt = -\int_T \frac{d\phi}{dt} i \cdot dt \qquad \text{Eq. A3.1}$$

We can integrate the RHS by parts:

$$\int_0^T i(t)\frac{d\phi(t)}{dt}dt = \left[i(t)\phi(t) - \int \phi(t)\frac{di(t)}{dt}dt\right]_0^T$$

$$= i(T)\phi(T) - i(0)\phi(0) - F(\phi(T), i(T)) + F(\phi(0), i(0)) \qquad \text{Eq. A3.2}$$

Since i(0) = i(T) and $\phi(0) = \phi(T)$ the first two terms cancel. If we let:

$$i(t) = g(\phi(t)) \qquad \text{Eq. A3.3}$$

i.e. a dependent flux, the second integral of equation A3.2 can be integrated by parts again after we first apply the chain rule:

$$\int \phi(t)\frac{di(t)}{dt}dt = \int \phi(t)\frac{dg(\phi(t))}{d\phi(t)}\frac{d\phi(t)}{dt}dt \qquad \text{Eq. A3.4}$$

Thus

$$\int_o^T \phi(t)\frac{dg(\phi(t))}{d\phi(t)}d\phi(t) = \left[\phi(t)g(\phi(t)) - \int g(\phi(t))\cdot 1 \cdot d\phi(t)\right]_0^T \qquad \text{Eq. A3.5}$$

$$= G(\phi(0)) - G(\phi(T)) = 0$$

The first term on the RHS cancels due to the flux being the same at the start and end of the cycle. The integrand on the RHS cancels for the same reason.

The proof in the above sheds more light on *the necessary condition for an independent flux: the flux must be constant for any current including zero current.* The proof also dispels *any form* of dependent relation, non-linear or even a delayed effect. If the equation A3.3 was:

$$i(t) = g(\phi(t - n))$$

We could expand this as a Taylor series about $g(\phi(t))$ but there would still be a relation, and the flux would still be dependent. Clearly the flux at step 4 to 1 of the magneto-calorific or step 3 to 1 of the temporary remnance cycles is not even a delayed dependent function of the current in the surrounding electromagnet; it could exist indefinitely if heat conduction didn't occur—it is an independent flux.

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Appendix 4: The Source of Energy on Field Collapse and the Magnitude of Electrical Power Generated

Simply, flux change through coil into a resistive load R:

$$P = \frac{V^2}{R} \Rightarrow \frac{\left(N\frac{d\theta}{dt}\right)^2}{R}$$

$$Power = \frac{N^2A^2\left(\frac{dB}{dt}\right)^2}{R}$$

We can write N=nL where n is the number of turns per unit length and L is the length of the core/coil. If we cycle F times per second, the *minimum* power output is:

$$P_{\min} = \frac{B^2F^2n^2V^2}{R}$$

Appendix 5: The Thermodynamics of the Magneto-calorific Effect Cycle

The energy of a dipole in a field is given by:

$$\Delta U_{core} = -\mu \cdot B$$

We can remodel equation A2.7 in Appendix 2 to add the new energy term. Now, however, we must work with specific quantities so we recast the dipole moment as the dipole moment per unit volume, I, which is also equal to the solenoidal current density multiplied by the cross-sectional area. Thus:

$$I = BA\varepsilon_0c^2 \qquad BA = \frac{I}{\varepsilon_0c^2}$$

We substitute the expression BA into the expression for ΔU:

$$\Delta U = \frac{n}{\varepsilon_0^2c^4}\frac{k}{R}IdI$$

This is then substituted into Equation A2.7, leading to:

$$dU = TdS + HdI + \frac{n}{\varepsilon_0^2c^4}\frac{k}{R}IdI$$

Routine manipulation, as in Appendix 2 in Equations A2.7-A2.10, leads to:

$$(\Delta T)_S = -\frac{T}{c_H + \frac{n}{\varepsilon_0^2c^4}\frac{k}{R}T\left(\frac{\partial I}{\partial T}\right)_H^2}\left(\frac{\partial I}{\partial T}\right)_H \Delta H$$

Thus we have a "virtual heat capacity" on step 4 to 1 of the thermodynamic cycle due to the extra term in the denominator summing with cH; the dipoles find it harder to randomize in the solenoid field around them. If we consider the net electrical work in an adiabatic cycle, we evaluate,

$$\oint HdI = \int_0^{I_M} HdI + \int_{I_M}^0 HdI = 0$$

However, in the second integral of the thermodynamic cycle, the symmetry is broken:

$$\int_0^{I_M} HdI + \int_{I_M}^0 H'dI < 0$$

For the same ΔT as the adiabatic case, we have altered the heat capacity with the "virtual heat capacity." Thus ΔH is not the same; it must be higher to maintain the equality since the heat capacity has gone up. We show this in the second integral with H'. It is as though we have pasted two half-adiabatic cycles together: the first integral is energy input on the first half of the adiabatic magneto-calorific cycle, the second integral the second half of the cycle coming from a much higher magnetization of a sample with a much higher heat capacity. We can reason this because at step 4 to 1 of the cycle, the magneto-calorific effect doesn't have to "know" or "remember" that in the previous step it was allowed to cool isothermally to ambient. The thermodynamic equations keep no "history" of the changes we took them through. All that matters is the exact differentials, the thermodynamic co-ordinates of the thermodynamic identity A1.7 at the start and end of a cycle, *i.e.*:

If $\quad dU(T,H) = \delta Q + \delta W$

And $\quad \oint dU = 0$

Then if $\quad \delta W > 0$

$\quad \Rightarrow \delta Q < 0$

The working substance returns to its initial coordinates and therefore has the same internal energy, but it did work so must have absorbed heat.

Appendix 6: Survey of the Maxwell Demon Problem

There are several reasons why the MD problem is not thought to be realizable.[11] Smoluchowski[7] and the account of his paper by this author,[8] and Feynman[9] dispel one type of these devices on grounds that a mechanical element of size commensurate to perform this would itself undergo Brownian Motion and be rendered ineffective.

Another form of the demon measures the speed of a molecule by its radiation temperature or with a pulse of light to measure by some means like a Doppler shift (let us call them Measurement-Action-Engines, MAEs). A gate is then opened to admit a sorting process. Kirchoff as early as 1859 pointed out that as a consequence of the Second Law of Thermodynamics that radiation from an isothermal system (black-body radiation) is uniform—we couldn't ascertain the speed by measurement of its radiation. Brillouin[10] recounts and collates papers dealing with this measurement aspect. He recounts that because of the "photon gas" pervading the isothermal environment, no estimation of the amount of matter that the enclosure contains could ever be made—it is independent of the matter. He then proves that energy greater than the black-body radiation must be injected into the enclosure, leading to a minimum increase in entropy of the universe of kTln2 per "bit" of information, and that this entropy can never be cancelled by the "negentropy" of the sorting process.

A further problem with MAEs is the resetting of the sorting

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apparatus at the end of the cycle. Szilard[8] realized that information would have to be kept on the state of the machine, which would be read and acted upon. For the same reason to the previous paragraph, Brillouin[10] proved that the minimum cost of information is kTln2 and that this couldn't be recovered.

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About the Author

Mr. Cornwall is a software and electronic/electrical engineer gaining degrees at UMIST and London Universities. He has spent several years in industry working at SIRA/IAL and PGS Tensor, mainly doing software engineering. In his spare time, Mr. Cornwall invents but has devoted the majority of his time to understanding the physics behind his thermal electric converter (TEC). In 2001, he went full-time with his project and now has secured funding to research and develop the TEC. Mr. Cornwall's other interests are all aspects of science, music, current affairs, and keeping fit (he hopes to compete in a triathalon next year).

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A Pollution SOLUTION

J. Gridelin

Never one to quail at world-engirdling problems, or to duck them, I merely goose my idea generator with a few recent news items and come up with solutions.

Some of them, of course—continuing the avian theme—are strictly for the birds.

I've done it for eliminating hurricanes whilst generating power and expanding fish populations (see *IE* #33). I've helped California while eliminating tooth decay and helping a small African country's balance of trade. And I've found freshwater resources for indebted Third World countries to sell.

So I took on pollution next.

Two notions suggest themselves: for water pollution (and only fresh water, can't do salt yet) there's the zebra mussel, the terror of the Great Lakes, an accidentally imported shellfish from Europe.

Shellfish, of course, strain water to feed themselves and in the course of it they absorb pollutants. (Source: *Toronto Star* outdoor sports columnist John Power, from a few years ago. Lake Erie or Ontario is cleaner than ever, duck populations are increasing because they eat mussels, though you wouldn't want to eat the ducks, I think. Remember the DDT in birds of prey issue from about 1970?)

For air pollution, specifically woodsmoke from wood-burning stoves, there's the old World War II-era technology of gasified wood.

Just run your woodstove inefficiently and without enough oxygen and you'll get plenty of gasified wood. Run this through a filter, cool it a little, and then into the intake manifold (no carburetor required!) of a common, everyday ordinary gasoline engine and you'll discover that the engine runs quite well on this unlikely fuel.

If you use a modern engine, in tune and equipped with the latest in California pollution-control equipment, you'll produce exhaust cleaner than Los Angeles smog.

Now hook this up to your leftover Y2K emergency generator (preferably a bigger generator, but. . .) and you'll produce electricity whilst cleaning the air.

Meanwhile, your under-utilized utility company can sell its excess power to California on the spot market and rake in the big dollars.

And maybe the price of power will drop. But beware of causing more pollution!

Anecdotal historical evidence from *New Scientist*, sometime in the summer of 2000, reveals that while these engines worked, they required lots of filter changes, as they clogged up with soot and ash and creosote rapidly.

Ah, well, it's old, traditional pollution.

There are two more forms of pollution to consider: ground (as in contaminated earth) and noise.

The traditional way to deal with contaminated soil is to dig it up and move it somewhere where people will complain about it. The traditional way to deal with noise pollution is to build a berm—a large, elongated mound of earth—around the source of the sound. Yes, you move in, ahem, a large quantity of earth.

These two sort of solve each other, don't they?

There you go: a part of water pollution, a little bit of air, some of ground and noise. Life's so simple for me I sometimes worry about brain pollution out there, but I can't prove it exists.

In the meantime. . .Got any more problems for me? ❑❑❑

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IN MEMORIAM

Richard Hazelett

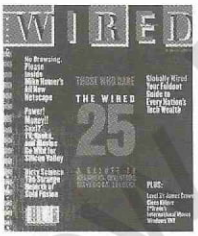
Richard Hazelett of Colchester, Vermont, an engineer and successful businessman in the machining industry, who was co-editor of the self-published book, *The Einstein Myth and the Ives Papers: A Counter-Revolution in Physics* (1979, ISBN-0-8159-5823-4), passed away shortly after the 9th Annual Meeting of the Natural Philosophy Alliance (NPA) at San Louis Obispo, California (May 13-17, 2002). He was a dedicated member of the NPA. The seminal Einsteinian relativity criticism of RCA television pioneer Herbert Eugene Ives, which was widely published in major peer-reviewed journals—and then "forgotten" and ignored by the establishment (see *IE* #38)—was resurrected by the work of Dick Hazelett. We will sorely miss him. In his later years, Dick spent much of his time in philosophical pursuits at the intersection of science and religion. He was born a Mormon, but later in life converted to Judaism.

Dr. Anthony C. Sutton

The outspoken editor of the newsletter *Future Technology and Intelligence Report*, Tony Sutton of Reno, Nevada, passed away in the summer of 2002—details are sketchy at this time. Sutton's newsletter covered many controversial subjects, among them research into new sources of energy and claimed cancer treatments—and their suppression. A correspondent, Gary Vesperman, informing me last November of Sutton's death, wrote, "Last summer Tony had passed on to continue his stubborn quest for truths in other worlds and universes."

WIRED Magazine

Cold Fusion Article Still Available



Read Charles Platt's 18-page exposé in the November 1998 issue: "Dirty Science: The Strange Rebirth of Cold Fusion."

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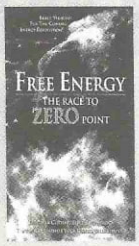

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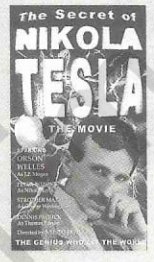

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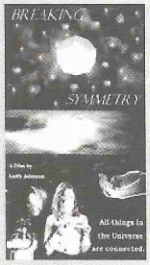

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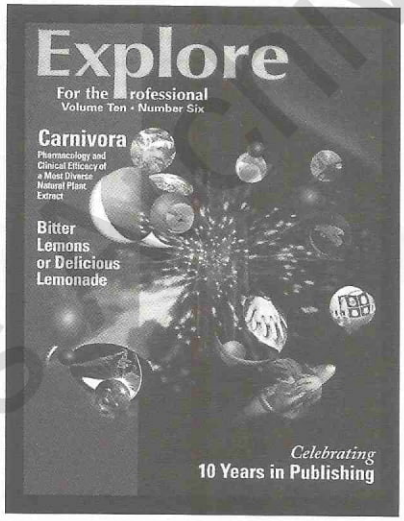

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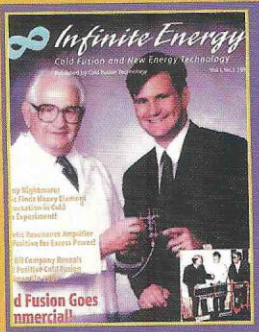

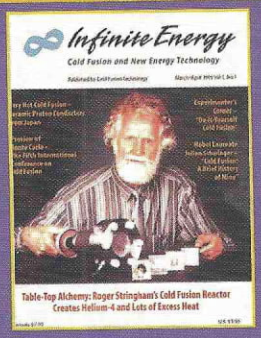

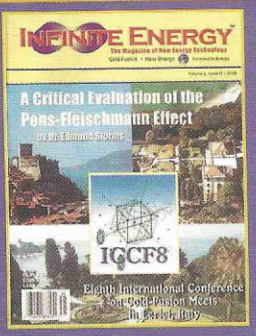

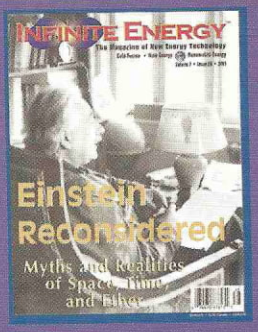

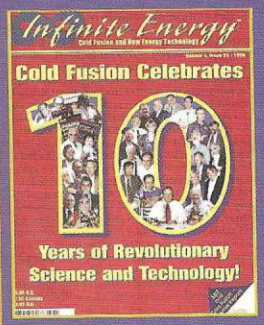

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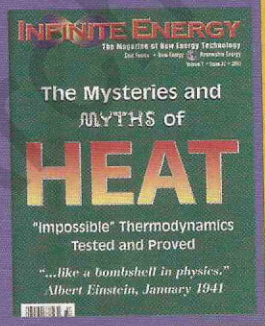

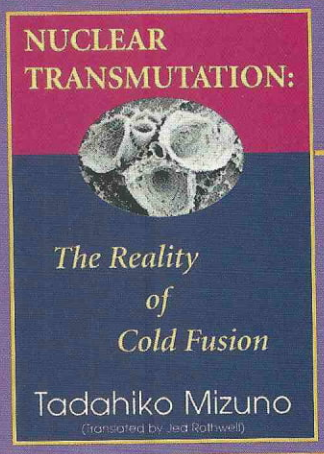

Nuclear Transmutation: The Reality of Cold Fusion

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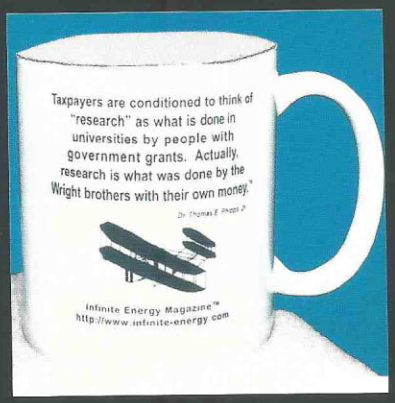

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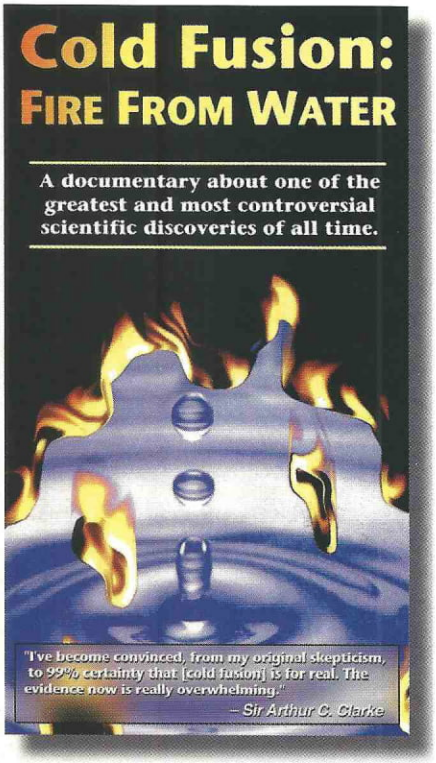

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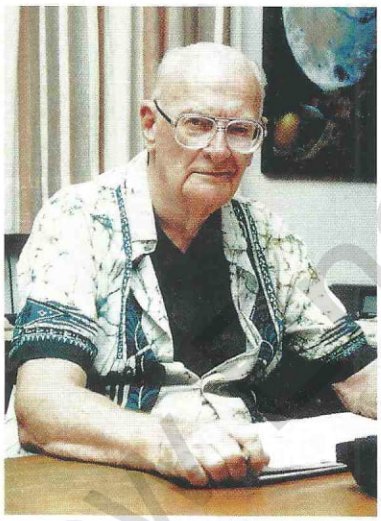

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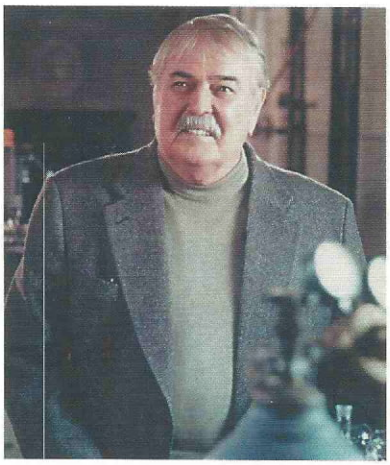

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